"A stunning achievement, steeped in science but suffused with magic."
—SIDDHARTHA MUKHERJEE, author of *THE GENE*

HOW ANIMAL SENSES REVEAL THE HIDDEN REALMS AROUND US

AN IMMENSE WORLD

ED YONG

PULITZER PRIZE–winning author of *I CONTAIN MULTITUDES*

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How do you know but ev’ry Bird
that cuts the airy way,
Is an immense world of delight,
clos’d by your senses five?

—WILLIAM BLAKE

Introduction

The Only True Voyage

Imagine an elephant in a room. This elephant is not the proverbial weighty issue but an actual weighty mammal. Imagine the room is spacious enough to accommodate it; make it a school gym. Now imagine a mouse has scurried in, too. A robin hops alongside it. An owl perches on an overhead beam. A bat hangs upside down from the ceiling. A rattlesnake slithers along the floor. A spider has spun a web in a corner. A mosquito buzzes through the air. A bumblebee sits upon a potted sunflower. Finally, in the midst of this increasingly crowded hypothetical space, add a human. Let's call her Rebecca. She's sighted, curious, and (thankfully) fond of animals. Don't worry about how she got herself into this mess. Never mind what all these animals are doing in a gym. Consider, instead, how Rebecca and the rest of this imaginary menagerie might perceive one another.

The elephant raises its trunk like a periscope, the rattlesnake flicks out its tongue, and the mosquito cuts through the air with its antennae. All three are smelling the space around them, taking in the floating scents. The elephant sniffs nothing of note. The rattlesnake detects the trail of the mouse, and coils its body in ambush. The mosquito smells the alluring carbon dioxide on Rebecca's

breath and the aroma of her skin. It lands on her arm, ready for a meal, but before it can bite, she swats it away—and her slap disturbs the mouse. It squeaks in alarm, at a pitch that is audible to the bat but too high for the elephant to hear. The elephant, meanwhile, unleashes a deep, thunderous rumble too low-pitched for the mouse's ears or the bat's but felt by the vibration-sensitive belly of the rattlesnake. Rebecca, who is oblivious to both the ultrasonic mouse squeaks and the infrasonic elephant rumbles, listens instead to the robin, which is singing at frequencies better suited to her ears. But her hearing is too slow to pick out all the complexities that the bird encodes within its tune.

The robin's chest looks red to Rebecca but not to the elephant, whose eyes are limited to shades of blue and yellow. The bumblebee can't see red, either, but it *is* sensitive to the ultraviolet hues that lie beyond the opposite end of the rainbow. The sunflower it sits upon has at its center an ultraviolet bullseye, which grabs the attention of both the bird and the bee. The bullseye is invisible to Rebecca, who thinks the flower is only yellow. Her eyes are the sharpest in the room; unlike the elephant or the bee, she can spot the small spider sitting upon its web. But she stops seeing much of anything when the lights in the room go out.

Plunged into darkness, Rebecca walks slowly forward, arms outstretched, hoping to feel obstacles in her way. The mouse does the same but with the whiskers on its face, which it sweeps back and forth several times a second to map its surroundings. As it skitters between Rebecca's feet, its footsteps are too faint for her to hear, but they are easily audible to the owl perched overhead. The disc of stiff feathers on the owl's face funnels sounds toward its

sensitive ears, one of which is slightly higher than the other. Thanks to this asymmetry, the owl can pinpoint the source of the mouse's skittering in both the vertical and horizontal planes. It swoops in, just as the mouse blunders within range of the waiting rattlesnake. Using two pits on its snout, the snake can sense the infrared radiation that emanates from warm objects. It effectively sees in heat, and the mouse's body blazes like a beacon. The snake strikes…and collides with the swooping owl.

All of this commotion goes unnoticed by the spider, which barely hears or sees the participants. Its world is almost entirely defined by the vibrations coursing through its web—a self-made trap that acts as an extension of its senses. When the mosquito strays into the silken strands, the spider detects the telltale vibrations of struggling prey and moves in for the kill. But as it attacks, it is unaware of the high-frequency sound waves that are hitting its body and bouncing back to the creature that sent them—the bat. The bat's sonar is so acute that it not only finds the spider in the dark but pinpoints it precisely enough to pluck it from its web.

As the bat feeds, the robin feels a familiar attraction that most of the other animals cannot sense. The days are getting colder, and it is time to migrate to warmer southern climes. Even within the enclosed gym, the robin can feel Earth's magnetic field, and, guided by its internal compass, it points due south and escapes through a window. It leaves behind one elephant, one bat, one bumblebee, one rattlesnake, one slightly ruffled owl, one extremely fortunate mouse, and one Rebecca. These seven creatures share the same physical space but experience it in wildly and wondrously different ways. The same is true for the billions of other animal species on the planet and the

countless individuals within those species.[*1] Earth teems with sights and textures, sounds and vibrations, smells and tastes, electric and magnetic fields. But every animal can only tap into a small fraction of reality's fullness. Each is enclosed within its own unique sensory bubble, perceiving but a tiny sliver of an immense world.

—

THERE IS A wonderful word for this sensory bubble—*Umwelt.* It was defined and popularized by the Baltic-German zoologist Jakob von Uexküll in 1909. Umwelt comes from the German word for "environment," but Uexküll didn't use it simply to refer to an animal's surroundings. Instead, an Umwelt is specifically the part of those surroundings that an animal can sense and experience—its *perceptual* world. Like the occupants of our imaginary room, a multitude of creatures could be standing in the same physical space and have completely different Umwelten. A tick, questing for mammalian blood, cares about body heat, the touch of hair, and the odor of butyric acid that emanates from skin. These three things constitute its Umwelt. Trees of green, red roses too, skies of blue, and clouds of white—these are not part of its wonderful world. The tick doesn't willfully ignore them. It simply cannot sense them and doesn't know they exist.

Uexküll compared an animal's body to a house. " Each house has a number of windows," he wrote, "which open onto a garden: a light window, a sound window, an olfactory window, a taste window, and a great number of tactile windows. Depending on the manner in which these windows are built, the garden changes as it is seen from the house. By no means does it appear as a section of a

larger world. Rather, it is the only world that belongs to the house—its [Umwelt]. The garden that appears to our eye is fundamentally different from that which presents itself to the inhabitants of the house."

This was a radical notion at the time—and in some circles, it might still be. Unlike many of his contemporaries, Uexküll saw animals not as mere machines but as sentient entities, whose inner worlds not only existed but were worth contemplating. Uexküll didn't exalt the inner worlds of humans over those of other species. Rather, he treated the Umwelt concept as a unifying and leveling force. The human's house might be bigger than the tick's, with more windows overlooking a wider garden, but we are still stuck inside one, looking out. Our Umwelt is still limited; it just doesn't *feel* that way. To us, it feels all-encompassing. It is all that we know, and so we easily mistake it for all there is *to* know. This is an illusion, and one that every animal shares.

We cannot sense the faint electric fields that sharks and platypuses can. We are not privy to the magnetic fields that robins and sea turtles detect. We can't trace the invisible trail of a swimming fish the way a seal can. We can't feel the air currents created by a buzzing fly the way a wandering spider does. Our ears cannot hear the ultrasonic calls of rodents and hummingbirds or the infrasonic calls of elephants and whales. Our eyes cannot see the infrared radiation that rattlesnakes detect or the ultraviolet light that the birds and the bees can sense.

Even when animals share the same senses with us, their Umwelten can be very different. There are animals that can hear sounds in what seems to us like perfect silence, see colors in what looks to us like total darkness, and sense vibrations in what feels to us like complete stillness. There

are animals with eyes on their genitals, ears on their knees, noses on their limbs, and tongues all over their skin. Starfish see with the tips of their arms, and sea urchins with their entire bodies. The star-nosed mole feels around with its nose, while the manatee uses its lips. We are no sensory slouches, either. Our hearing is decent, and certainly better than that of the millions of insects that have no ears at all. Our eyes are unusually sharp, and can discern patterns on animal bodies that the animals themselves cannot see. Each species is constrained in some ways and liberated in others. For that reason, this is not a book of lists, in which we childishly rank animals according to the sharpness of their senses and value them only when their abilities surpass our own. This is a book not about superiority but about diversity.

This is also a book about animals as animals. Some scientists study the senses of other animals to better understand ourselves, using exceptional creatures like electric fish, bats, and owls as "model organisms" for exploring how our own sensory systems work. Others reverse-engineer animal senses to create new technologies: Lobster eyes have inspired space telescopes, the ears of a parasitic fly have influenced hearing aids, and military sonar has been honed by work on dolphin sonar. These are both reasonable motivations. I'm not interested in either. Animals are not just stand-ins for humans or fodder for brainstorming sessions. They have worth in themselves. We'll explore their senses to better understand *their* lives. " They move finished and complete, gifted with extensions of the senses we have lost or never attained, living by voices we shall never hear," wrote the American naturalist Henry Beston. "They are not brethren, they are not underlings; they are other nations, caught with ourselves in the net of

life and time, fellow prisoners of the splendour and travail of the earth."

—

A FEW TERMS will act as guideposts on our journey. To sense the world, animals detect *stimuli*—quantities like light, sound, or chemicals—and convert them into electrical signals, which travel along neurons toward the brain. The cells that are responsible for detecting stimuli are called *receptors:* Photoreceptors detect light, chemoreceptors detect molecules, and mechanoreceptors detect pressure or movement. These receptor cells are often concentrated in *sense organs,* like eyes, noses, and ears. And sense organs, together with the neurons that transmit their signals and the parts of the brain that process those signals, are collectively called *sensory systems*. The visual system, for example, includes the eyes, the photoreceptors inside them, the optic nerve, and the visual cortex of the brain. Together, these structures give most of us the sense of sight.

The preceding paragraph could have been pulled from a high school textbook. But take a moment to consider the miracle of what it describes. Light is just electromagnetic radiation. Sound is just waves of pressure. Smells are just small molecules. It's not obvious that we should be able to detect *any* of those things, let alone convert them into electrical signals or derive from those signals the spectacle of a sunrise, or the sound of a voice, or the scent of baking bread. The senses transform the coursing chaos of the world into perceptions and experiences—things we can react to and act upon. They allow biology to tame physics. They turn stimuli into *information*. They pull relevance

from randomness, and weave meaning from miscellany. They connect animals to their surroundings. And they connect animals to each other via expressions, displays, gestures, calls, and currents.

The senses constrain an animal's life, restricting what it can detect and do. But they also define a species' future, and the evolutionary possibilities ahead of it. For example, around 400 million years ago, some fish began leaving the water and adapting to life on land. In open air, these pioneers—our ancestors—could see over much longer distances than they could in water. The neuroscientist Malcolm MacIver thinks that this change spurred the evolution of advanced mental abilities, like planning and strategic thinking. Instead of simply reacting to whatever was directly in front of them, they could be proactive. By seeing farther, they could think ahead. As their Umwelten expanded, so did their minds.

An Umwelt cannot expand indefinitely, though. Senses always come at a cost. Animals have to keep the neurons of their sensory systems in a perpetual state of readiness so that they can fire when necessary. This is tiring work, like drawing a bow and holding it in place so that when the moment comes, an arrow can be shot. Even when your eyelids are closed, your visual system is a monumental drain on your reserves. For that reason, no animal can sense everything well.

Nor would any animal want to. It would be overwhelmed by the flood of stimuli, most of which would be irrelevant. Evolving according to their owner's needs, the senses sort through an infinity of stimuli, filtering out what's irrelevant and capturing signals for food, shelter, threats, allies, or mates. They are like discerning personal assistants who come to the brain with only the most important

information.[*2] Writing about the tick, Uexküll noted that the rich world around it is “ constricted and transformed into an impoverished structure” of just three stimuli. “However, the poverty of this environment is needful for the certainty of action, and certainty is more important than riches.” Nothing can sense everything, and nothing needs to. That is why Umwelten exist at all. It is also why the act of contemplating the Umwelt of another creature is so deeply human and so utterly profound. Our senses filter in what we need. We must choose to learn about the rest.

—

THE SENSES OF animals have fascinated people for millennia, but mysteries still abound. Many of the animals whose Umwelten are most different from ours live in habitats that are inaccessible or impenetrable—murky rivers, dark caves, open oceans, abyssal depths, and subterranean realms. Their natural behavior is hard to observe, let alone to interpret. Many scientists are limited to studying creatures that can be kept in captivity, with all the strangeness that entails. Even in labs, animals are challenging to work with. Experiments that might reveal how they use their senses are hard to design, especially when those senses are drastically different from ours.

Amazing new details—and, sometimes, entirely new senses—are being discovered regularly. Giant whales have a volleyball-sized sensor at the tip of their lower jaw, which was only discovered in 2012 and whose function is still unclear. Some of the stories in these pages are decades or centuries old; others emerged as I was writing. And there’s still so much we can’t explain. “My dad, who is an atomic physicist, once asked me a bunch of questions,” Sonke

Johnsen, a sensory biologist, tells me. “After a few *I don’t know*s, he said: *You guys really don’t know anything*.” Inspired by that conversation, Johnsen published a paper in 2017 entitled “We Don’t Really Know Anything, Do We? Open Questions in Sensory Biology.”

Consider the seemingly simple question *How many senses are there?* Around 2,370 years ago, Aristotle wrote that there are five, in both humans and other animals—sight, hearing, smell, taste, and touch. This tally persists today. But according to the philosopher Fiona Macpherson, there are reasons to doubt it. For a start, Aristotle missed a few in humans: proprioception, the awareness of your own body, which is distinct from touch; and equilibrioception, the sense of balance, which has links to both touch and vision.

Other animals have senses that are even harder to categorize. Many vertebrates (animals with backbones) have a second sensory system for detecting odors, governed by a structure called the vomeronasal organ; is this part of their main sense of smell, or something separate? Rattlesnakes can detect the body heat of their prey, but their heat sensors are wired to their brain’s visual center; is their heat sense simply part of vision, or something distinct? The platypus’s bill is loaded with sensors that detect electric fields and sensors that are sensitive to pressure; does the platypus’s brain treat these streams of information differently, or does it wield a single sense of electrotouch?

These examples tell us that “ senses cannot be clearly divided into a limited number of discrete kinds,” Macpherson wrote in *The Senses.* Instead of trying to shove animal senses into Aristotelian buckets, we should instead study them for what they are.[*3] Though I have organized

this book into chapters that revolve around specific stimuli, like light or sound, that's largely for convenience. Each chapter is a gateway into the varied things that animals do with each stimulus. We will not concern ourselves with counting senses, nor talk nonsensically about a "sixth sense." We will instead ask how animals use their senses, and attempt to step inside their Umwelten.

It won't be easy. In his classic 1974 essay, "What Is It Like to Be a Bat?," the American philosopher Thomas Nagel argued that other animals have conscious experiences that are inherently subjective and hard to describe. Bats, for example, perceive the world through sonar, and since this is a sense that the majority of humans lack, " there is no reason to suppose that it is subjectively like anything we can experience or imagine," Nagel wrote. You could envision yourself with webbing on your arms or insects in your mouth, but you'd still be creating a mental caricature of *you* as a bat. "I want to know what it is like for a *bat* to be a bat," Nagel wrote. "Yet if I try to imagine this, I am restricted to the resources of my own mind, and those resources are inadequate to the task."

In thinking about other animals, we are biased by our own senses and by vision in particular. Our species and our culture are so driven by sight that even people who are blind from birth will describe the world using visual words and metaphors.[*4] You agree with people if you *see* their point, or share their *view*. You are oblivious to things in your *blind spots.* Hopeful futures are *bright* and *gleaming;* dystopias are *dark* and *shadowy*. Even when scientists describe senses that humans lack altogether, like the ability to detect electric fields, they talk about *images* and *shadows*. Language, for us, is both blessing and curse. It gives us the tools for describing another animal's Umwelt

even as it insinuates our own sensory world into those descriptions.

Scholars of animal behavior often discuss the perils of anthropomorphism—the tendency to inappropriately attribute human emotions or mental abilities to other animals. But perhaps the most common, and least recognized, manifestation of anthropomorphism is the tendency to forget about other Umwelten—to frame animals' lives in terms of *our* senses rather than *theirs*. This bias has consequences. We harm animals by filling the world with stimuli that overwhelm or befuddle their senses, including coastal lights that lure newly hatched turtles away from the oceans, underwater noises that drown out the calls of whales, and glass panes that seem like bodies of water to bat sonar. We misinterpret the needs of animals closest to us, stopping smell-oriented dogs from sniffing their environments and imposing the visual world of humans upon them. And we underestimate what animals are capable of to our own detriment, missing out on the chance to understand how expansive and wondrous nature truly is—the delights that, as William Blake wrote, are "clos'd by your senses five."

Throughout this book, we'll encounter animal abilities that others had long thought impossible or absurd. Zoologist Donald Griffin, who co-discovered the sonar of bats, once wrote that biologists have been overly swayed by what he called "simplicity filters." That is, they seemed reluctant to even consider that the senses they were studying might be more complex and refined than whatever data they had collected could suggest. This lament contradicts Occam's razor, the principle that states that the simplest explanation is usually the best. But this principle is only true *if you have all the necessary information to*

hand. And Griffin's point was that you might not. A scientist's explanations about other animals are dictated by the data she collects, which are influenced by the questions she asks, which are steered by her imagination, which is delimited by her senses. The boundaries of the human Umwelt often make the Umwelten of others opaque to us.

Griffin's words are not carte blanche to put forward convoluted or paranormal explanations for animal behavior. I see them, and Nagel's essay, as a call for humility. They remind us that other animals are sophisticated, and that, for all our vaunted intelligence, it is very hard for us to understand other creatures, or to resist the tendency to view their senses through our own. We can study the physics of an animal's environment, look at what they respond to or ignore, and trace the web of neurons that connects their sense organs to their brains. But the ultimate feats of understanding—working out what it's like to be a bat, or an elephant, or a spider—always require what psychologist Alexandra Horowitz calls " an informed imaginative leap."

Many sensory biologists have backgrounds in the arts, which may enable them to see past the perceptual worlds that our brains automatically create. Sonke Johnsen, for example, studied painting, sculpture, and modern dance well before he studied animal vision. To represent the world around us, he says, artists already have to push against the limits of their Umwelt and "look under the hood." That capacity helps him "think about animals having different perceptual worlds." He also notes that many sensory biologists are perceptually divergent. Sarah Zylinski studies the vision of cuttlefish and other cephalopods; she has prosopagnosia and can't recognize even familiar faces, including her mother's. Kentaro

Arikawa studies color vision in butterflies; he is red-green color-blind. Suzanne Amador Kane studies the visual and vibrational signals of peacocks; she has slight differences in her color vision in each eye, so that one gives her a slightly reddish tint. Johnsen suspects that these differences, which some might bill as “disorders,” actually predispose people to step outside their Umwelten and embrace those of other creatures. Perhaps people who experience the world in ways that are considered atypical have an intuitive feeling for the limits of typicality.

We can all do this. I began this book by asking you to conjure a room full of hypothetical animals, and I’m asking you to perform similar feats of imagination over the next 13 chapters. The task will be hard, as Nagel predicted. But there is value and glory in the striving. On this journey through nature’s Umwelten, our intuitions will be our biggest liabilities, and our imaginations will be our greatest assets.

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ONE LATE MORNING in June 1998, Mike Ryan hiked into the Panamanian rainforest to search for animals with his former student Rex Cocroft. Usually, Ryan would have looked for frogs. But Cocroft had taken a liking to sap-sucking insects called treehoppers, and he had something cool to show his friend. Heading out from their research station, the duo pulled off a road and walked along a river. Once Cocroft spotted the right kind of shrub, he turned over a few leaves and quickly found a family of tiny treehoppers of the species *Calloconophora pinguis*. Cocroft had found a mother surrounded by babies, their black

backs capped with forward-pointing domes that looked like Elvis's hair.

Treehoppers communicate by sending vibrations through the plants on which they stand. These vibrations are not audible but can be easily converted into sounds. Cocroft clipped a simple microphone to the plant, handed Ryan some headphones, and told him to listen. Then he flicked the leaf. Immediately the baby treehoppers ran away, while producing vibrations by contracting muscles in their abdomens. "I figured it was probably going to be some kind of scurrying noise," Ryan recalls. "And what I heard instead was like cows mooing." The sound was deep, resonant, and unlike anything you'd expect from an insect. As the babies settled down and returned to their mother, their cacophony of vibrational moos turned into a synchronized chorus.

Still watching them, Ryan took the headphones off. All around him, he heard birds singing, howler monkeys roaring, and insects chirping. The treehoppers were quiet. Ryan put the headphones back on, "and I was transported into a totally different world," he tells me. Once more, the jungle noises dropped out of his Umwelt, and the mooing treehoppers returned. "It was the coolest experience," he says. "It was sensory travel. I was in the same place, but stepping between these two really cool environments. It was such a stark demonstration of Uexküll's idea."

The Umwelt concept can feel constrictive because it implies that every creature is trapped within the house of its senses. But to me, the idea is wonderfully expansive. It tells us that all is not as it seems and that everything we experience is but a filtered version of everything that we *could* experience. It reminds us that there is light in darkness, noise in silence, richness in nothingness. It hints

at flickers of the unfamiliar in the familiar, of the extraordinary in the everyday, of magnificence in mundanity. It shows us that clipping a microphone onto a plant can be an intrepid act of exploration. Stepping between Umwelten, or at least trying to, is like setting foot upon an alien planet. Uexküll even billed his work as a "travelogue."

When we pay attention to other animals, our own world expands and deepens. Listen to treehoppers, and you realize that plants are thrumming with silent vibrational songs. Watch a dog on a walk, and you see that cities are crisscrossed with skeins of scent that carry the biographies and histories of their residents. Watch a swimming seal, and you understand that water is full of tracks and trails. "When you look at an animal's behavior through the lens of that animal, suddenly all of this salient information becomes available that you would otherwise miss," Colleen Reichmuth, a sensory biologist who works with seals and sea lions, tells me. "It's like a magic magnifying glass, to have that knowledge."

Malcolm MacIver argues that when animals moved onto land, the greater range of their vision spurred the evolution of planning and advanced cognition: Their Umwelten expanded, and so did their minds. Similarly, the act of delving into other Umwelten allows us to see further and think more deeply. I'm reminded of Hamlet's plea to Horatio that "there are more things in heaven and Earth… than are dreamt of in your philosophy." The quote is often taken as an appeal to embrace the supernatural. I see it rather as a call to better understand the natural. Senses that seem paranormal to us only appear this way because we are so limited and so painfully unaware of our limitations. Philosophers have long pitied the goldfish in its

bowl, unaware of what lies beyond, but our senses create a bowl around us too—one that we generally fail to penetrate.

But we can try. Science-fiction authors like to conjure up parallel universes and alternate realities, where things are similar to this one but slightly different. Those exist! We will visit them one at a time, beginning with the most ancient and universal of senses—the chemical ones, like smell and taste. From there, via an unexpected route, we'll visit the realm of vision, the sense that dominates the Umwelt of most people but that still holds surprises galore. We'll stop to savor the delightful world of color before heading into the harsher territories of pain and heat. We'll sail smoothly through the various mechanical senses that respond to pressure and movement—touch, vibration, hearing, and the most impressive use of hearing, echolocation. Then, as experienced sensory travelers whose imaginations have been fully primed, we'll make our most difficult imaginative leaps yet, through the strange senses that animals use to detect the electric and magnetic fields that we cannot. Finally, at journey's end, we'll see how animals unify the information from their senses, how humans are polluting and distorting that information, and where our responsibilities to nature now lie.

As the writer Marcel Proust once said, " The only true voyage…would be not to visit strange lands but to possess other eyes…to see the hundred universes that each of them sees." Let us begin.

SKIP NOTES

*1 To understand how varied senses can be in a single species, just look at humans. For some people, red and green look identical. For others, body odor

smells like vanilla. For yet others, coriander (cilantro) tastes of soap.

*2 In 1987, German scientist Rüdiger Wehner described these as “matched filters”—aspects of an animal’s sensory systems that are tuned to the sensory stimuli that it most needs to detect.

*3 If you were being maximally reductive, you could reasonably argue that there are really only two senses—chemical and mechanical. Chemical senses include smell, taste, and vision. Mechanical senses include touch, hearing, and electrical senses. The magnetic sense might belong to either category or both. This framework will probably make absolutely no sense right now, but should become clearer as you continue in the book. I’m not especially wedded to it, but it is one possible way of thinking about the senses—and one that might appeal to the lumpers among you.

*4 Let me just say that avoiding visual metaphors when describing other senses is extremely difficult over the length of an entire book. I have tried to do so, or at least to be judicious and explicit whenever I have to resort to visual terms.

1.

Leaking Sacks of Chemicals

Smells and Tastes

"I DON'T THINK HE'S BEEN in here before," Alexandra Horowitz tells me. "So it should be very smelly."

By "he," she means Finnegan—her ink-black Labrador mix, who also goes by Finn. By "here," she means the small, windowless room in New York City in which she runs psychological experiments on dogs. By "smelly," she means that the room should be bursting with unfamiliar aromas, and thus should prove interesting to Finn's inquisitive nose. And so it does. As I look around, Finn smells around. He explores nostrils-first, intently sniffing the foam mats on the floor, the keyboard and mouse on the desk, the curtain draped over a corner, and the space beneath my chair. Compared to humans, who can explore new scenes by subtly moving our heads and eyes, a dog's nasal explorations are so meandering that it's easy to see them as random and thus aimless. Horowitz thinks of them differently. Finn, she notes, is interested in objects that people have touched and interacted with. He follows trails and checks out spots where other dogs have been. He examines vents, door cracks, and other places where moving air imports new odorants—scented molecules.[*1] He sniffs different parts of the same object, and he'll sniff them at different distances, "like he's approaching the Van Gogh and seeing what the brushstrokes look like up close," says Horowitz. "They're in that state of olfactory exploration all the time."

Horowitz is an expert on dog olfaction—their sense of smell—and I'm here to talk with her about all things sniffy and nasal. And yet, I'm so relentlessly visual that when Finn finishes nosing around and approaches me, I'm instantly drawn to his eyes, which are captivating and brown like the darkest chocolate.[*2] It takes concerted effort to refocus on what's right in front of them—his nose, prominent and moist, with two apostrophe-shaped nostrils curving to the side. This is Finn's main interface with the world. Here's how it works.

Take a deep breath, both as demonstration and to gird yourself for some necessary terminology. When you inhale, you create a single airstream that allows you to both smell and breathe. But when a dog sniffs, structures within its nose split that airstream in two. Most of the air heads down into the lungs, but a smaller tributary, which is for smell and smell alone, zooms to the back of the snout. There it enters a labyrinth of thin, bony walls that are plastered with a sticky sheet called the olfactory epithelium. This is where smells are first detected. The epithelium is full of long neurons. One end of each neuron is exposed to the incoming airstream and snags passing odorants using specially shaped proteins called odorant receptors. The other end is plugged directly into a part of the brain called the olfactory bulb. When the odorant receptors successfully grab their targets, the neurons notify the brain, and the dog perceives a smell. You can breathe out now.

Humans share the same basic machinery, but dogs just have more of everything: a more extensive olfactory epithelium, dozens of times more neurons in that epithelium, almost twice as many kinds of olfactory receptors, and a relatively larger olfactory bulb.[*3] And their hardware is packed off into a separate compartment,

while ours is exposed to the main flow of air through our noses. This difference is crucial. It means that whenever we exhale, we purge the odorants from our noses, causing our experience of smell to strobe and flicker. Dogs, by contrast, get a smoother experience, because odorants that enter their noses tend to stay there, and are merely replenished by every sniff.

The shape of their nostrils adds to this effect. If a dog is sniffing a patch of ground, you might imagine that every exhalation would blow odorants on the surface *away* from the nose. But that's not what happens. The next time you look at a dog's nose, notice that the front-facing holes taper off into side-facing slits. When the animal exhales while sniffing, air exits through those slits and creates rotating vortices that waft fresh odors *into* the nose. Even when breathing out, a dog is *still* sucking air in. In one experiment, an English pointer (who was curiously named Sir Satan) created an uninterrupted inward airstream for 40 seconds, despite exhaling 30 times during that period.

With such hardware, it's no wonder that dog noses are incredibly sensitive. But how sensitive? Scientists have tried to find the thresholds at which dogs can no longer smell certain chemicals, but their answers are all over the place, varying by factors of 10,000 from one experiment to another.[*4] Rather than focusing on these dubious statistics, it's more instructive to look at what dogs can actually do. In past experiments, they have been able to tell identical twins apart by smell. They could detect a single fingerprint that had been dabbed onto a microscope slide, then left on a rooftop and exposed to the elements for a week. They could work out which direction a person had walked in after smelling just five footsteps. They've been trained to detect bombs, drugs, landmines, missing people,

bodies, smuggled cash, truffles, invasive weeds, agricultural diseases, low blood sugar, bedbugs, oil pipeline leaks, and tumors.

Migaloo can find buried bones at archeological sites. Pepper uncovers lingering oil pollution on beaches. Captain Ron detects turtle nests so that the eggs can be collected and protected. Bear can pinpoint hidden electronics, while Elvis specializes in pregnant polar bears. Train, who flunked out of drug detection school for being too energetic, now uses his nose to track the scat of jaguars and mountain lions. Tucker used to hang off the bow of boats and sniff for orca poop; he has since retired, and his duties now fall to Eba. If it has a scent, a dog can be trained to detect it. We redirect their Umwelten in service of our needs, to compensate for our olfactory shortcomings. These feats of detection are worth marveling at, but they are also parlor tricks. They allow us to abstractly appreciate that dogs have a great sense of smell, without truly appreciating what that means for their inner lives or how their olfactory world differs from a visual one.

Unlike light, which always moves in a straight line, smells diffuse and seep, flood and swirl. When Horowitz observes Finn sniffing a new space, she tries to ignore the clear edges that her vision affords, and instead pictures “a shimmering environment, where nothing has a hard boundary,” she says. “There are focal areas, but everything is sort of seeping together.” Smells travel through darkness, around corners, and in other conditions that vex vision. Horowitz can’t see into the bag slung over the back of my chair, but Finn can *smell* into it, picking up molecules drifting from the sandwich within. Smells linger in a way that light does not, revealing history.[*5] The past occupants of Horowitz’s room have left no ghostly visual traces, but

their chemical imprint is there for Finn to detect. Smells can arrive before their sources, foretelling what's to come. The scents unleashed by distant rain can clue people in to advancing storms; the odorants emitted by humans arriving home can send their dogs running to a door. These skills are sometimes billed as extrasensory, but they are simply sensory. It's just that things often become apparent to the nose before they appear to the eyes. When Finn sniffs, he is not merely assessing the present but also reading the past and divining the future. And he is reading biographies. Animals are leaking sacks of chemicals, filling the air with great clouds of odorants.[*6] While some species deliberately send messages by releasing smells, all of us inadvertently do so, giving away our presence, position, identity, health, and recent meals to creatures with the right noses.[*7]

"I never thought much about the nose at all," says Horowitz. "It didn't occur to me."[*8] When she started studying dogs, she focused on things like their attitudes to unfairness—the kind of topic that's interesting to psychologists. But after reading Uexküll and thinking about the Umwelt concept, she shifted her attention to smell—the kind of topic that's interesting to *dogs.*

She notes, for example, that many dog owners deny their animals the joys of sniffing. To a dog, a simple walk is an odyssey of olfactory exploration. But if an owner doesn't understand that and instead sees a walk as simply a means of exercise or a route to a destination, then every sniffy act becomes an annoyance. When the dog pauses to examine some invisible trace, it must be hurried along. When the dog sniffs at poop, a carcass, or something the owner's senses find displeasing, it must be pulled away. When the dog sticks its nose in the crotch of another dog, it's being

indecorous: Bad dog! After all, in Western cultures at least, humans don't smell each other.[*9] "You could give someone a hug, but if you actually sniffed them, that would be very weird," says Horowitz. "I could say that your hair smells great, but I can't say that *you* smell great, unless we're intimate." Time and again, people impose their values—and their Umwelt—onto their dogs, forcing them to look instead of sniff, dimming their olfactory worlds and suppressing an essential part of their caninehood. That was never clearer to Horowitz than when she took Finn to a nosework class.

Oddly billed as a sport, these classes simply train dogs to find hidden scents, under increasingly difficult conditions. That should come naturally, but it didn't to many of the animals in Finn's class. Several seemed to lack any agency: They had to be pulled from box to box by their owners, or were completely unsure what to do. Others became agitated in the presence of other dogs and barked at them. But after a summer of sniffing, those behavioral quirks diminished. The reticent dogs regained their volition. The reactive dogs became tolerant. All seemed more easygoing. Fascinated, Horowitz and her colleague Charlotte Duranton ran their own experiment with 20 dogs. In front of each animal, Duranton placed a bowl in one of three locations: one where the bowl always contained food, a second where it was always empty, and a third where the outcome was ambiguous. The dogs quickly learned to approach the food-filled bowl and ignore the empty one. What about the ambiguous one? A dog's willingness to approach *that* bowl indicates what a cognitive psychologist might call *positive judgment bias* and what everyone else might call *optimism*. Horowitz found that dogs became more optimistic after just two weeks of nosework. As their sense of smell brightened, so did their outlook. (By

contrast, dogs didn’t change after two weeks of heelwork—an owner-led obedience activity that involves neither olfaction nor autonomy.)

For Horowitz, the implications are clear: Let dogs be dogs. Appreciate that their Umwelt is different, and lean into that difference. She does this by taking Finn on dedicated smell walks, when he’s allowed to sniff to his olfactory bulb’s content. If he stops, she stops. His nose sets the pace. The walks are slower, but she has no destination in mind. We go on such a walk together, heading a few blocks west of her office and into Manhattan’s Riverside Park. It’s a hot summer’s day, and the air is redolent with garbage, urine, and exhaust—and that’s only what I can smell. Finn detects more. He runs his nose along the cracks in the pavement. He investigates a traffic sign. He pauses to sniff a hydrant “because it’s been visited by all the other dogs of Columbia University,” Horowitz says. Sometimes she’ll see Finn sniff a fresh patch of urine, raise his head, look around (or smell around), and find the dog that just left it. The smell isn’t just an object unto itself but a reference point, and the walk isn’t just an intermediate state between points A and B but a tour of Manhattan’s layered, unseen stories.

Once we’re inside the park, the air fills with greenery, cut grass, mulch, and barbecues. Another dog walks past and Finn turns to breathe in an odor sample, puffing his cheeks out like a cigar smoker. Two large poodles approach, but before they can get close, their owner pulls them away and body-checks them against a fence. Horowitz looks sad. She’s happier when a female Australian shepherd arrives and circles Finn, both enthusiastically sniffing each other’s genitals, while we make small talk with the owner. We glean the other dog’s sex through

pronouns; Finn worked it out through smell. We ask about her age; Finn can guess. We don't ask about her health or readiness to mate; Finn doesn't need to ask. "There was a time when I would try to smell what he's smelling, but I do that less often simply because I know I'm not getting what he's getting," Horowitz says. But there's room for improvement. Though the human nose lacks the anatomical complexity of a dog's and is unhelpfully farther from the ground, it is also underused. By taking more sniffs herself, and paying closer attention to odors, Horowitz says that she has become a better smeller (and a more socially awkward one). "We have perfectly good noses. We just don't use them as well as the dog."

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A FUNNY THING happens when you mention dogs to neuroscientists who study olfaction in humans, as Horowitz learned while writing her book *Being a Dog*. They get a little territorial, a little…well…sniffy. Some dislike that dogs get treated like special olfactory paragons when many other mammals are excellent smellers, including rats (which can also detect landmines), pigs (whose olfactory epithelium can be twice as large as a German shepherd's), and elephants (which we'll get to later). Others point to massive discrepancies in studies that test dogs' ability to detect specific odors. These have variously claimed that dogs are a billion times more sensitive than humans, or a million times, or just ten thousand times. In some cases, humans do *better:* Of 15 odorants where both species have been tested, humans outperformed our canine companions on five, including beta-ionone (cedar wood) and amyl acetate (bananas). People also excel at discriminating

between smells. While it's easy to find two colors that humans can't tell apart, it's very hard to find indistinguishable pairs of odors. Neuroscientist John McGann has tried, and tells me, "We tried odors that *mice* can't tell apart and humans were like: No, we've got this."

Yet textbooks still claim our sense of smell is terrible. McGann traced the origin of this pernicious myth to the nineteenth century. In 1879, neuroscientist Paul Broca noted that our olfactory bulbs are relatively puny compared to those of other mammals. He reasoned that smell is a base and animalistic sense, and the loss of it was necessary for us to have higher thought and free will. He then classified us (along with other primates and whales) as non-smellers. The label stuck, even though Broca never actually measured how well animals smell, relying instead on sketchy inferences based on the dimensions of their brains. Compared to a mouse, a human has an olfactory bulb smaller relative to other parts of the brain, but also physically bigger, with roughly as many neurons. It's not clear what any one of these metrics says about an animal's experience of smell.[*10]

The textbook perspective is also a Western one, based on cultures where smell has long been undervalued. Plato and Aristotle argued that olfaction was too vague and ill-formed to produce anything other than emotional impressions. Darwin deemed it to be " of extremely slight service." Kant said that " smell does not allow itself to be described, but only compared through similarity with another sense." The English language confirms his view with just three dedicated smell words: *stinky, fragrant,* and *musty*. Everything else is a synonym (*aromatic, foul*), a very loose metaphor (*decadent, unctuous*), a loan from another sense (*sweet, spicy*), or the name of a source (*rose, lemon*). Of the

five Aristotelian senses, four have vast and specific lexicons. Smell, as Diane Ackerman wrote, “ is the one without words.”

The Jahai people of Malaysia would disagree, as would the Semaq Beri, the Maniq, and the many other hunter-gatherer groups who have dedicated smell vocabularies. The Jahai use a dozen words for smells and smell alone. One describes the scent in gasoline, bat droppings, and millipedes. Another is for some quality shared by shrimp paste, rubber tree sap, tigers, and rotten meat. Yet another refers to soap, the pungent durian fruit, and the popcorn-like twang of the binturong.[*11] They “have this ease of talking about smells,” says psychologist Asifa Majid, who found that the Jahai can name smells as easily as English-speakers can name colors. Just as tomatoes are red, the binturong is *ltpit.* Smell is also a fundamental part of their culture. Once, Majid was told off by Jahai friends for sitting too close to her research partner and allowing their smells to mingle. Another time, she tried to name the smell of a wild ginger plant; children mocked her not only for failing but also for treating the whole plant as a single object, when the stem and flowers *obviously* had distinct smells. The myth of poor human olfaction “might have been overridden much earlier if the humans under consideration had been Jahai instead of Brits and Americans,” Majid tells me.

Even Westerners can pull off surprising olfactory feats when given the chance. In 2006, neuroscientist Jess Porter took blindfolded students to a park in Berkeley and asked them to follow a 10-meter trail of chocolate oil that she had drizzled on the grass. The students got down on all fours, snuffled about like dogs, and looked ridiculous. But they succeeded, and got better with practice.

When I visit Alexandra Horowitz, she challenges me to the same test and lays some chocolate-scented string on the floor. Eyes closed and nostrils open, I kneel down and sniff away. I quickly pick up the smell of chocolate and follow it. When I lose the scent, I cast my head from side to side, exactly like a dog would. But there end the similarities. A dog can sniff six times a second, wafting a steady conveyor of air over its olfactory receptors. I start to hyperventilate after several consecutive sniffs, and when I pause to exhale, I lose the trail. I succeed in tracking the string, but it takes me a minute to do what Finn manages in half a second. Even if I practiced regularly, I couldn't come close; I don't have the hardware. And crucially, Horowitz adds after whipping away the string, a dog can still follow a trail once the odor source is gone. We both try, bending down to sniff. "I don't smell anything left," she says. We humans underestimate our sense of smell, but it's also clear that we simply don't live in the same olfactory world as a dog. And that world is so complicated that it's a wonder we can make sense of it at all.

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MANY LIVING THINGS can sense light. Some can respond to sound. A select few can detect electric and magnetic fields. But every thing, perhaps without exception, can detect chemicals. Even a bacterium, which consists of just one cell, can find food and avoid danger by picking up on molecular clues from the outside world. Bacteria can also release their own chemical signals to communicate with each other, launching infections and performing other coordinated actions only when their numbers are large enough. Their signals can then be detected and exploited

by bacteria-killing viruses, which have a chemical sense even though they are such simple entities that scientists disagree about whether they're even alive. Chemicals, then, are the most ancient and universal source of sensory information. They've been part of Umwelten for as long as Umwelten have existed. They're also among the hardest parts of it to understand.

Scientists who work on vision and hearing have it comparatively easy. Light and sound waves can be defined by clear and measurable properties like brightness and wavelength, or loudness and frequency. Shine wavelengths of 480 nanometers into my eyes, and I'll see blue. Sing a note with a frequency of 261 hertz (Hz), and I'll hear middle C. Such predictability simply doesn't exist in the realm of smells. The variation among possible odorants is so wide that it might as well be infinite. To classify them, scientists use subjective concepts like intensity and pleasantness, which can only be measured by asking people. Even worse, there are no good ways of predicting what a molecule smells like—or even if it smells at all—from its chemical structure.[*12] And yet, many animals naturally grapple with the intricacy of olfaction, without any training in chemistry or neuroscience. Their noses are kings of infinite space. How do they work?

The basics became clearer after Linda Buck and Richard Axel made a pivotal discovery in 1991. In work that would earn them a Nobel Prize, the duo identified a large group of genes that produce odorant receptors—the proteins that initially recognize smelly molecules.[*13] We encountered them earlier in this chapter while discussing dogs, but they underlie the sense of smell throughout the animal kingdom. The odorant receptors probably recognize their target molecules, like electric sockets accepting certain cables.

[*14] When this happens, the neurons that harbor these receptors send signals to the smell centers of the brain, and the animal perceives a scent. But the details of this process are still murky. There aren't enough receptors to account for the huge range of possible odorants, so the perception of scent must depend on the combination of olfactory neurons that are firing. If one group goes off, you delight at the scent of a rose. If another group activates, you wince at the whiff of vomit. Such a code must exist, but its nature is still mostly mysterious.

Odorant receptors can also vary from one individual to another in dramatic ways. For example, the OR7D4 gene creates a receptor that responds to androstenone, the chemical behind the stench of sweaty socks and body odor. To most people, it's repulsive. But to a lucky few who inherit a slightly different version of OR7D4, androstenone smells like *vanilla*. That's just one receptor out of hundreds, and all exist in varied forms, bestowing every individual with their own subtly personalized Umwelt. Everyone likely smells the world in a slightly different way. And if it's that hard to appreciate the olfactory Umwelt of another human, imagine how hard the task becomes for another species.

We should be skeptical of any claim that pits one animal's sense of smell against another's. I have repeatedly read that an elephant's sense of smell is five times more sensitive than a bloodhound's, but that's an utterly meaningless statement. Does that mean the elephant detects five times more chemicals? Does it sense certain chemicals at a fifth the concentration, or from five times the distance? Does it remember smells for five times as long? Such comparisons will always be flawed because smell is diverse and often unquantifiable. We need to stop asking "How good is an animal's sense of smell?" Better

questions would be “How important is smell to that animal?” and “What does it use its sense of smell for?”

Male moths, for example, are tuned to sexual chemicals released by females. They pick up these odorants from miles away using feathery antennae, and slowly flutter over to the source. Smell is so important to them that when scientists transplanted the antennae of female sphinx moths onto males, the recipients behaved like females, seeking out the scent of egg-laying sites instead of mates. Their sense of smell is clearly amazing, as evidenced by the continued existence of moths. But they only put this amazing sense toward a few specific tasks. Moths have been described as “odor-guided drones,” and that’s not an exaggeration. Many males don’t even have mouthparts when they reach adulthood. Freed from the need to feed, their short lives are devoted to flying, finding, and…mating. Their behaviors are simple enough that they can be easily diverted. By mimicking female moth odors, bolas spiders can lure male moths into fatal ambushes, while farmers can lure them into traps. Other insects, however, process smells in more sophisticated ways.

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IN A LAB in New York City, Leonora Olivos Cisneros pulls out a large Tupperware container and lifts the lid to reveal a writhing sea of dark-red dots. They’re ants. Specifically, they’re clonal raiders—an obscure species that’s stockier than most ants and, unusually, has neither queens nor males. Every individual is female and every one can reproduce by cloning herself. About 10,000 of them are scurrying around the container. Most have formed a makeshift nest from their own bodies and are tending to

their young grubs. The rest are wandering around in search of food. Olivos Cisneros feeds them on other ants, including escamoles—the larvae of a much larger species that she brings over from Mexico.

The clonal raiders are so small that it's hard to focus on any one of them. Under the microscope, they're much easier to see, not just because they've been magnified but also because Olivos Cisneros has painted them. With practiced hands, she uses insect pins to dab splotches of yellow, orange, magenta, blue, and green onto the insects' backs, giving each individual a unique color code that can be tracked by an automated camera system. The colors also make them easier to observe by eye. Every now and then, I notice one of them tapping at another with the tips of its clubby antennae. This action, delightfully known as antennating, is the ant equivalent of a sniff. It's the means through which they inspect the chemicals on each other's bodies and discern colony-mates from interlopers. These ants normally live underground and are completely blind. "There's nothing visual going on," Daniel Kronauer, who leads the lab, tells me. "In terms of their communication, everything is chemical."

The chemicals they use are pheromones—an important term that is frequently misunderstood. It refers to chemical signals that carry messages between members of *the same species*. Bombykol, which female moths use to attract males, is a pheromone; the carbon dioxide that draws mosquitoes to my body is not. Pheromones are also *standardized messages,* whose use and meaning do not vary between individuals of a given species. All female silk moths use bombykol and all males are attracted to it; by contrast, the smells that distinguish one person's scent from another's are *not* pheromones. Indeed, despite the

existence of pheromone parties where singletons sniff each other's clothes, or pheromone sprays that are marketed as aphrodisiacs, it's still unclear if human pheromones even exist. Despite decades of searching, none have been identified.[*15]

Ant pheromones are another story. There are many, and ants put them to different uses depending on their properties. Lightweight chemicals that easily rise into the air are used to summon mobs of workers that can rapidly overwhelm prey, or to raise fast-spreading alarms. Crush the head of an ant, and within seconds, nearby colony-mates will sense the aerosolized pheromones and charge into battle. Medium-weight chemicals that become airborne more slowly are used to mark trails. Workers lay these down when they find food, leading other colony-mates to foraging hotspots. As more workers arrive, the trail is strengthened. As the food runs out, the trail decays. Leafcutter ants are so sensitive to their trail pheromone that a milligram is enough to lay a path around the planet three times over. Finally, the heaviest chemicals, which barely aerosolize, are found on the surface of the ants' bodies. Known as cuticular hydrocarbons, they act as identity badges. Ants use them to discern their own species from other kinds of ants, nestmates from other colonies, and queens from workers. Queens also use these substances to stop workers from breeding or to mark unruly subjects for punishment.

Pheromones hold such sway over ants that they can force the insects to behave in bizarre and detrimental ways, in disregard of other pertinent sensory cues. Red ants will look after the caterpillars of blue butterflies, which look nothing like ant grubs but *smell* exactly like them. Army ants are so committed to following their pheromone trails

that if those paths should accidentally loop back onto themselves, hundreds of workers will walk in an endless “death spiral” until they die from exhaustion.[*16] Many ants use pheromones to discern dead individuals: When the biologist E. O. Wilson daubed oleic acid onto the bodies of living ants, their sisters treated them as corpses and carried them to the colony’s garbage piles. It didn’t matter that the ant was alive and visibly kicking. What mattered was that it *smelled* dead.

“ The ant world is a tumult, a noisy world of pheromones being passed back and forth,” Wilson said. “We don’t see it, of course. We don’t see anything more than these little ruddy creatures scurrying around on the ground, but there’s a huge amount of activity, of coordination and communication going on.” That’s all based on pheromones. These smelly substances allow ants to transcend the limits of individuality and act as a superorganism, producing complex and transcendent behaviors from the unknowing actions of simple individuals. They allow army ants to act as unstoppable predators, Argentine ants to create supercolonies that extend for miles, and leafcutter ants to develop their own agriculture by gardening fungi. Ant civilizations are among the most impressive on Earth, and as ant researcher Patrizia d’Ettorre once wrote, their “genius is definitely in their antennae.”

Kronauer’s research with the clonal raider ant shows how that genius might have evolved. Ants are essentially a group of highly specialized wasps that evolved between 140 and 168 million years ago and rapidly transitioned from a solitary existence to an extremely social one. Along the way, their repertoire of odorant receptor genes—the ones that allow them to sense smelly chemicals—ballooned in size. While fruit flies have 60 of these genes and

honeybees have 140, most ants have between 300 and 400, and the clonal raider has a record-breaking 500.[*17] Why? Here are three clues. First, a third of the clonal raiders' odorant receptors are only produced on the underside of their antennae—the parts that they pat each other with during antennation. Second, these receptors specifically detect the heavyweight pheromones that ants wear as identity badges. Third, these 180 or so receptors all arose from just one gene, which was repeatedly duplicated at roughly the time that ancestral ants went from living alone to living in colonies. Putting these clues together, Kronauer reasons that all that extra olfactory hardware might have helped ants to better recognize their nestmates. After all, they are not only looking for the presence or absence of *one* pheromone but weighing up the relative proportions of a few dozen of them. That's a challenging computation, but one that undergirds everything else that ants do. By expanding their powers of smell, they gained the means of regulating their sophisticated societies.

It becomes especially obvious how much ants rely on smell when they are disconnected from that sense. When Kronauer deprived his clonal raiders of a gene called *orco,* which odorant receptors need to detect their target molecules, the mutant ants behaved in entirely un-ant-like ways. "Right from the beginning, there was something wrong with those ants," Olivos Cisneros tells me. "It was super-easy to spot." They wouldn't follow pheromone trails. They ignored barriers whose intense smells would ward off normal ants, like lines drawn by Sharpies. They ignored the grubs that they're normally duty-bound to care for. They ignored their colonies altogether, and went walkabout on their own for days at a time. If they accidentally found themselves within a colony, their presence was disruptive.

Sometimes they'd release alarm pheromones without provocation, sending their nestmates into an unnecessary panic. "They can't tell that there are other ants there," Kronauer says. "They just can't sense them at all." It's hard not to feel sorry for them. An ant without olfaction is an ant without a colony, and an ant without a colony is barely an ant at all.[*18]

Ants are perhaps the most dramatic example of the power of pheromones, but they're hardly the only ones. Female lobsters urinate into the faces of males to tempt them with a sex pheromone. Male mice produce a pheromone in their urine that makes females especially attracted to other components in their odor; this substance is called darcin, after *Pride and Prejudice*'s male hero. The early spider-orchid deceives male bees into carrying its pollen by mimicking their sexual pheromones. " We live, all the time, especially in nature, in great clouds of pheromones," E. O. Wilson once said. "They're coming out in spumes in millionths of a gram that can travel for maybe a kilometer." These tailored messages drive the entire animal kingdom, from the smallest of creatures to the very biggest.

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IN 2005, LUCY Bates arrived in Kenya's Amboseli National Park to study its elephants. On her first day out, her experienced field assistants told her that these animals, which had been observed by scientists since the 1970s, would almost certainly realize that a fresh face had joined the research group. Bates was skeptical. How would they know? Why would they care? But as soon as the team found one of the herds and switched off their vehicle's engine, the

elephants immediately turned toward them. “One of them came up, stuck her trunk in my window, and had a good sniff,” Bates tells me. “They knew someone new was inside.”

Over the next few years, Bates came to realize what anyone who spends time with elephants knows: Their lives are dominated by smell. You don’t need to know about an elephant’s record-breaking catalog of 2,000 olfactory receptor genes, or the size of its olfactory bulb. Just watch the trunk. No other animal has a nose so mobile and conspicuous, and so no other animal is as easy to watch in the act of smelling. Whether an elephant is walking or feeding, alarmed or relaxed, its trunk is constantly in motion, swinging, coiling, twisting, scanning, sensing. Sometimes the entire 6-foot organ periscopes dramatically to inspect an object. Sometimes its movements are subtle. “You can approach a feeding elephant who’s heard you coming, and without turning its head, it’ll flick just the tip of its trunk toward you,” says Bates.

African elephants can use their trunks to detect their favorite plants, even when obscured in lidded boxes, and even when hidden among a messy botanical buffet. They can learn unfamiliar smells: After being briefly taught to detect TNT, which is supposedly odorless to humans, three African elephants could identify the substance more skillfully than highly trained detection dogs. Two of those same elephants, Chishuru and Mussina, could sniff a human and identify the matching scent from a row of nine jars laced with the odors of different people. Asian elephants are no slouches, either. In one study, they could correctly identify which of two covered buckets contained more food through smell alone—a feat that humans can’t duplicate and that (in one of Alexandra Horowitz’s

experiments) even dogs struggled with.[*19] “We could tell the difference if we looked, but if we were just smelling it, there’s no way,” says Bates. “The level of information they can get is just so far beyond what we can comprehend.”

Elephants can also smell danger. Some time after Bates arrived in Amboseli, one of her colleagues gave a ride to a couple of Maasai men in a jeep that the team had used for decades. The next day, when the team drove out, the elephants were unexpectedly cautious around the familiar vehicle. Young Maasai men will sometimes spear elephants, and Bates reasoned that the creatures were disconcerted by the lingering scents in the jeep—some combination of the cows that the Maasai raise, the dairy products they eat, and the ochre they daub on their bodies. To test this idea, she hid various bundles of clothes in elephant country. When the animals approached washed garments or those worn by the Kamba, who pose no threat to them, they were curious but unconcerned. But every time they got wind of clothes worn by the Maasai, their reactions were unmistakable. “Once the first trunk went up, the whole group *ran* away as fast as they could, and almost always into long grass,” Bates tells me. “It was incredibly stark—every group, every time.”

Food and foes aside, few sources of odor are as pertinent to an elephant as other elephants. They’ll regularly inspect each other with their trunks, probing away at glands, genitals, and mouths. When African elephants reunite after a prolonged separation, they go through intense greeting rituals. Human observers can see their flapping ears and hear their throaty rumbles, but for the elephants themselves, the experience must also be olfactory pandemonium. They vigorously urinate and

defecate, while aromatic liquid pours forth from glands behind their eyes, filling the air around them with scents.

Few people have done more to study elephant odors than Bets Rasmussen,[*20] a biochemist who was once crowned “the queen of elephant secretions, excretions and exhalations.” If an elephant produced it, Rasmussen likely sniffed it and possibly tasted it. Those secretions, she realized, are full of pheromones, and thus full of meaning. In 1996, after 15 years of work, she isolated a chemical called Z-7-dodecen-1-yl acetate, which females release in their urine to inform bulls that they’re ready to mate. It was astonishing that just one compound could so greatly affect the sex lives of so complex an animal. It was even more astonishing that female moths attract males with the same substance. Fortunately, male moths aren’t drawn to female elephants, because the attractant is just one of several compounds on their search list. Luckier still, male elephants don’t try to mate with female moths, because the latter produce piddling amounts of the pheromone. Other elephants, however, shine like odorous beacons. Rasmussen eventually discovered that elephants can tell, through smell, when females are at different parts of their estrus cycles, or when bulls are in the hyperaggressive sexual state called musth. They can also identify individuals. As they walk the time-worn trails that connect their home ranges, they leave dung and urine behind—not waste, but personal stories to be read by the trunks of others around them.

In 2007, Lucy Bates found a clever way of testing this idea. She followed family groups of elephants and waited for one to urinate. Once the herd had left, she drove over, scooped up the urine-soaked soil with a trowel, and placed it in an ice cream tub. She then drove around the savannah

until she found either the same herd of elephants or a different one. Cutting them off, she emptied the container of soil onto the path ahead of them, sped off to a distant vantage point, and waited. “It was not the most pleasant experiment,” she tells me. “Often, you’d think you know where they were going and put the sample out, and they’d change direction. That was quite soul-destroying.” When she got it right, the elephants would always inspect the urine as they approached. If it came from a different family group, they quickly ignored it. If it came from a family member who wasn’t part of the current unit, they showed more interest. But if it came from an elephant who was part of the same group *and walking behind them,* they were especially curious. They knew exactly who had left the urine, and since that individual couldn’t possibly have teleported ahead, they seemed confused and carefully investigated the displaced scent. Elephants move in large family groups, and it seems they know not only who’s around but where those individuals are. Scent cements that awareness. “The amount of information that they must be picking up all the time as they’re walking along, from all the different smells they’re taking in…I think it just must be overwhelming,” says Bates.

The exact nature of that information is hard to discern. Smells aren’t easily captured, so while scientists can photograph an animal’s displays and record its calls, those who care about olfaction have to do things like scoop up urine-soaked soil. Smells aren’t easily reproduced, either: You can’t play back an odor through a speaker or a screen, so researchers have to do things like drive piss-soaked soil in front of elephant herds. And that’s if they think about olfaction at all. In many cases, elephant researchers have tested the brains of these animals through experiments

that are implicitly visual and involve objects like mirrors. How much have we missed about an elephant's mind because we've ignored its primary senses?

When they walk their favorite routes and encounter the smelly deposits of other elephants, what are they getting besides identity? Do they know the emotional states of those previous passers-by? Can they sense stress or diagnose illnesses? What of their wider environment? Elephants that have returned to postwar Angola seem to skirt around the millions of landmines that still dot the land—unsurprising, perhaps, given how quickly they can be trained to detect TNT. They've been known to dig wells in times of drought, and George Wittemyer, who has also worked in Amboseli, is sure that they're using the smell of buried water to do so. He also thinks that they can detect approaching rain from the smells it unleashes as it splashes onto faraway soils. "That smell is exhilarating," he tells me. "It makes me feel excited and alive, and you'll also see elephants rising up to it."

Rasmussen once speculated that elephants might guide their long migrations using "chemical memories of landscapes, terrain, pathways, mineral and salt sources, waterholes, the scenting of rain or flooding rivers, and tree odors signifying seasons." No one has tested these claims, but they make sense. After all, dogs, humans, and ants can all track trails of scent. Salmon can return to the very streams in which they were born by homing in on the distinctive scents of those natal waters.[*21] Whip spiders use the smell sensors on the tips of their extremely long, thread-like front legs to find their way back to their shelters amid the clutter of a rainforest. Polar bears might be able to navigate across thousands of miles of indistinct ice because glands in their paws leave scent behind with

every step. These examples are so common that some scientists believe the main purpose of animal olfaction isn't to detect chemicals but to use them in navigating through the world. With the right noses, landscapes can be mapped as odorscapes, and fragrant landmarks can show the way to food and shelter. Ironically, the best evidence for such feats comes from animals that, until recently, were thought to be unable to smell.

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JOHN JAMES AUDUBON, the avid naturalist and artist, was best known for painting North America's birds, and compiling those pieces into a seminal ornithological tome. But he was also responsible for seeding a centuries-long falsehood about birds through some truly abysmal experiments involving vultures.

Since Aristotle, scholars believed that vultures had a keen sense of smell. Audubon thought differently. When he left a putrefying pig carcass in the open, no vultures came to eat. By contrast, when he put out a deerskin stuffed with straw, a turkey vulture swooped in and pecked away. These birds, he claimed in 1826, find their food with sight, not smell. His supporters bolstered that claim with equally dodgy evidence. One noted that vultures would attack a painting of an eviscerated sheep, and that captive vultures refused to eat after being blinded. Another showed that a turkey—not a turkey vulture, mind you; an actual turkey—would still eat food that was tainted with sulfuric acid and potassium cyanide, a strong-smelling concoction that proved violently fatal. These bizarre studies struck a chord. Never mind that vultures prefer fresh carcasses and ignore overly stinky meat like the kind Audubon used. Forget that

Audubon confused black vultures (which are less reliant on smell) with turkey vultures, or that oil paints at the time gave off certain chemicals also found in decaying flesh. Disregard the many reasons a mutilated animal might not feel very peckish. The idea that turkey vultures—and by dubious extension, *all birds*—can't smell became textbook wisdom. Evidence to the contrary was ignored for decades, and the study of avian olfaction lapsed into neglect.[*22]

Betsy Bang revitalized it. An amateur ornithologist and medical illustrator, she dissected the nasal passages of bird after bird and sketched what she saw. And what she saw—large cavities filled with convoluted scrolls of thin bone, much like what lurks within a dog's snout—convinced her that birds must be able to smell. Why else would they have all that hardware? Concerned that the textbooks were spouting misinformation, Bang spent the 1960s carefully examining the brains of more than a hundred species and measuring their olfactory bulbs. She showed that these smell centers were especially large in turkey vultures, the kiwis of New Zealand, and the tubenoses—a group of seabirds that includes albatrosses, petrels, shearwaters, and fulmars. Tubenoses are named for the obvious nostrils on their beaks, which were originally thought to be channels for expelling salt. Bang's work suggested another purpose: The tubes draw air into the nose, allowing the birds to catch the scent of food while soaring over the ocean. For them, "olfaction is of primary importance," Bang wrote.[*23] ("She didn't mind taking on a fight, even if it meant taking on Audubon," her son Axel later said.)

Elsewhere in California, Bernice Wenzel had come to the same conclusion. A physiology professor (and one of the few women in the United States to hold such a position in the 1950s), Wenzel showed that when homing pigeons

catch a whiff of scented air, their hearts beat faster and the neurons in their olfactory bulbs buzz excitedly. She repeated that test with other birds—turkey vultures, quails, penguins, ravens, ducks—and all reacted similarly. She proved what Bang deduced: Birds can smell. Both Bang and Wenzel, who have since passed away, have been described as “mavericks of their generation” who pushed against incorrect dogma and allowed others to explore a sensory world that was deemed nonexistent. And because of the examples they set and the mentorship they offered, many of the scientists who followed in their footsteps were also women.

One, Gabrielle Nevitt, was in the audience when Wenzel discussed her seabird studies in one of her final pre-retirement talks. Inspired, Nevitt began a career-long quest to find out how tubenoses make use of smell. Beginning in 1991, she would get onto any Antarctic voyage that she could, while trying “to figure out how to test birds from the deck of an icebreaker without getting killed,” she tells me. She’d soak tampons in fish oils and fly them from kites. She’d release slicks of pungent oils from the sterns of ships. And every time, tubenoses arrived quickly. Nevitt suspected that the birds were drawn to a specific chemical within the pungent glop, but she didn’t know what it might be, or how the birds found it across featureless water. She only learned the answer on a later Antarctic voyage, and in unexpected circumstances.

During the trip, a fierce storm rocked Nevitt’s ship, throwing her across her room and slamming her into a tool chest. She tore her kidney and was confined to her bunk, even after her ship had docked and a fresh crew had come on board. Still recuperating, Nevitt chatted with the new chief scientist—an atmospheric chemist named Tim Bates,

who had come to study a gas called dimethyl sulfide, or DMS. In the oceans, plankton release DMS when they're eaten by krill—shrimp-like animals that are, in turn, eaten by whales, fish, and seabirds. DMS doesn't dissolve easily in water, and eventually makes its way into the air. If it rises high enough, it seeds clouds. If it enters the nose of a sailor, it evokes an odor that Nevitt describes as "a lot like oysters" or "kind of seaweed-y." It's the scent of the sea.

In particular, DMS is the scent of *bountiful* seas, where huge blooms of plankton feed equally huge swarms of krill. As Nevitt talked to Bates, it dawned on her that DMS was exactly the chemical she had envisioned—an olfactory dinner bell that alerted seabirds when waters were teeming with prey. Bates cemented this impression by giving Nevitt a map that showed DMS levels across parts of Antarctica. In the varying levels of the chemical, Nevitt saw a seascape of odorous mountains and unscented valleys. She realized that the ocean wasn't as featureless as she had once imagined; rather, it had a secret topography that was invisible to the eye but evident to the nose. She began to perceive the sea the way a seabird might.

Once back on her feet, Nevitt carried out a string of studies that confirmed the DMS hypothesis. She found that tubenoses will flock to slicks of the chemical. She calculated that they can detect it at the kind of low, feeble traces that might realistically drift on the wind. She showed that some tubenoses are drawn to DMS before they can even fly.[*24] Many species nest in deep burrows, and their chicks, which resemble grapefruit-sized balls of lint, hatch into a world of darkness. Their early Umwelt is bereft of light but awash in odor, wafting in from the burrow entrance or carried in on the beaks and feathers of their parents. These hatchlings have no knowledge of the ocean,

but they know to head toward DMS. And even after they emerge into the light, trading their claustrophobic nurseries for the immensity of the sky, smells remain their north star. They soar for thousands of miles, searching for diffuse plumes of scent that might betray the presence of krill beneath the surface.[*25]

But smells are more than dinner bells. In the ocean, they're also signposts. Geological features, like submerged mountains or slopes in the seafloor, affect the levels of nutrients in the water, which in turn influence concentrations of plankton, krill, and DMS. The smellscapes that seabirds track are intimately tied to actual landscapes, and so are surprisingly predictable. Over time, Nevitt suspects, seabirds build up a map of these features, using their noses to learn the locations of the richest feeding spots and their home nests.

This is a hard idea to test, but Anna Gagliardo found compelling evidence for it. She transported a few Cory's shearwaters—a kind of tubenose—to locations 500 miles from their nesting colonies and temporarily shut down their sense of smell with a nasal wash. When released, these birds struggled to travel home, taking weeks or months to do what normal shearwaters did in mere days. Without smell, they lost their way. Without smell, the ocean was stripped of landmarks. As the writer Adam Nicolson described in *The Seabird's Cry,* " What may be featureless to us, a waste of undifferentiated ocean, is for them rich with distinction and variety, a fissured and wrinkled landscape, dense in patches, thin in others, a rolling olfactory prairie of the desired and the desirable, mottled and unreliable, speckled with life, streaky with pleasures and dangers, marbled and flecked, its riches often hidden

and always mobile, but filled with places that are pregnant with life and possibility."

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SHEARWATERS, DOGS, ELEPHANTS, and ants all smell with different organs, but they all smell in stereo, using a pair of nostrils or antennae. By comparing the odorants that land on each side, they can track the source of a scent. Even humans can do this: The string-tracking task that Alexandra Horowitz asked me to try is much harder if one nostril is blocked. Directionality comes more easily to a paired detector, which also explains the distinctive shape of one of nature's least likely but most effective smell organs —the forked tongue of snakes.

Snake tongues come in shades of lipstick red, electric blue, and inky black. Outstretched and splayed, they can be longer and wider than their owners' heads. Kurt Schwenk has been fascinated by them for decades, and he often finds that he's alone in that. In the second year of his PhD, he told a fellow student what he was working on, eager to revel in the joys of scientific pursuits with a like-minded soul. The student (who is now a famous ecologist) burst out laughing. "That would have been enough to hurt my feelings, but this was a guy who studied the mites that hang out in the nostrils of hummingbirds," Schwenk tells me, still slightly outraged. "Someone who studied hummingbird nostril mites thought that what *I* did was funny! For some reason, people find tongues funny."

Perhaps there's something unseemly about studying organs that are linked to carnal delights like sex and food. Perhaps it's weird to seriously investigate things that we protrude in jest or defiance. Or perhaps it's that the forked

tongue has become a symbol of malevolence and duplicity. Whatever the case, serious scholars have put forward some very strange hypotheses for how snakes use their tongues, or for why those tongues are forked. Some have described them as venomous stingers, or fly-catching forceps, or tactile organs akin to hands, or even nostril-cleaning tools. Aristotle suggested that the fork doubled the pleasure that a snake gets from its food—but the snake's tongue has no taste buds and conveys no sensory information on its own. Instead, as scientists finally discovered in the 1920s, it's a chemical collector. When it darts into the world, its tips snag odor molecules that lie on the ground or drift through the air. When it retracts, saliva sweeps the chemical bounty into a pair of chambers—the vomeronasal organ—that connect to the brain's smell centers.[*26] With the aid of its tongue, a snake *smells* the world. Each flick is the equivalent of a sniff. Indeed, the very first thing that a hatchling serpent does upon breaking out of its egg is to flick its tongue. "That tells you something about the primacy of the sense," Schwenk says.

Using its tongue, a male garter snake can track a slithering female by following the trail of pheromones she leaves behind. By comparing what she deposited on different sides of objects she pushed against, he can work out her direction. Once he finds her, he can gauge her size and health, possibly with just one or two flicks. He can do this all in the dark. A male can even be fooled into vigorously mating with a paper towel that has been imbued with a female's scent. But all of these feats could be just as easily accomplished with a paddle-shaped, human-esque tongue. So why do snakes have forked ones? Schwenk reasoned that the fork allows snakes to smell in stereo, by comparing chemical traces at two points in space. If both

tips detect trail pheromones, the snake stays on course. If the right tip gets a hit but the left one doesn’t, the snake veers right. If both come up empty, it swings its head from side to side until it regains the trail. The fork allows the snake to precisely define the edges of the path.

As a timber rattlesnake slithers over the forest floor, its tongue turns the world into both map and menu, revealing the crisscrossing tracks of scurrying rodents and discerning the scents of different species. Amid the tangled trails, it can pick out those of its favorite prey[*27] and find sites where those tracks are common and fresh. It hides nearby, coiled in ambush. When a rodent runs past, the snake explodes outward four times faster than a human can blink. It stabs the rodent with its fangs and injects venom. The toxins usually take a while to work, and since rodents have sharp teeth, the snake avoids injury by releasing its prey and letting it run off. After several minutes, it starts flicking its tongue to track down the now-dead victim. The venom helps. Aside from lethal toxins, rattlesnake venom also includes compounds called disintegrins, which aren’t toxic but react with a rodent’s tissues to release odorants. The snakes can use these aromas to distinguish envenomated rodents from healthy ones and to tell rodents envenomated by *their own species* from those bitten by other kinds of rattlesnakes. They can even track the specific individual that they attacked because they instantly learn the victim’s scent at the moment of a bite. “There are presumably odors of multiple mice around, but they know which trail to follow,” Schwenk says.

Snakes can also catch trails of scent on the breeze. Chuck Smith, one of Schwenk’s former students, demonstrated this by implanting copperheads with radio transmitters and tracking their movements. Twice, he

released a female snake into the wild and watched as she stayed in exactly the same place. She couldn't have left a scent trail, but she still managed to attract males who were randomly wandering hundreds of yards away, then suddenly crawled directly to her in a straight line.

Schwenk guessed that their secret lies in the way they flick. Lizards, the group from which snakes evolved, also smell with their tongues, which are also sometimes forked. But when lizards stick their tongues out, they usually flick once. The tips extend, scrape the ground, and retract. Snakes, without exception, flick repeatedly and rapidly, often never touching the ground. The tongues bend in the middle as if moving on a hinge, and the tips carve out a wide circular arc, 10 to 20 times a second. Bill Ryerson, another of Schwenk's students, analyzed those movements by getting snakes to tongue-flick into clouds of cornstarch. He illuminated the clouds with laser light, and filmed the swirling particles with high-speed cameras. When Schwenk saw the footage, "my brain nearly exploded," he says.

It turns out that the tongue's tips splay out at the ends of each flick and get closer at the midpoint. This motion creates two donut-shaped rings of continuously moving air that draw in odorants from the left and right sides of the snake. It's as if the snake temporarily conjures up two large fans that suck in odors from either side, concentrating diffuse odor molecules onto the tips of its tongue. And since the odors come in from left and right, the fork can still provide a sense of direction, even when flicking in air.

This style of smelling is unusual in two ways. First, it involves a tongue, which is traditionally an organ of taste—a sense that snakes barely use, for reasons I'll get to. Second, it involves an organ that, in most other animals, is either nonexistent or of secondary importance. Many

backboned animals have *two* distinct systems for detecting odors. The main one includes all the structures, receptors, and neurons that I described in the head of a dog at the start of this chapter. The vomeronasal organ is its sidekick; it has its own kinds of odor-sensing cells, its own sensory neurons, and its own connections to the brain. It's usually found inside the nasal cavity, just above the roof of the mouth. Don't bother trying to feel around for yours, though. For some reason, humans lost our vomeronasal organ during our evolution, as did other apes, along with whales, birds, crocodiles, and some bats.

Most other mammals, reptiles, and amphibians have kept theirs. When one elephant touches another with its trunk and brings the pheromone-coated tip into its mouth, those molecules head to the vomeronasal. When horses or cats curl back their upper lip to expose their teeth, they're cutting off their nostrils and sending inhaled odorants to the vomeronasal. And when a snake retracts its tongue and squeezes the tips between the floor and roof of its mouth, the collected molecules are squirted to the vomeronasal. In snakes, this sidekick is the star. Without it, garter snakes stop following trails and stop eating, while rattlesnakes botch half their strikes and fail to capture what they hit. These snakes can still inhale odorants through their nostrils, but their "main" olfactory system can't seem to do much with that information. It has been relegated to a passive role, informing the brain if there's something interesting around to tongue-flick at.

Snakes are unusual not just because their vomeronasal organ is so important but also because we actually understand what it does. In other animals, the organ is a mystery, albeit one that seems to attract confident claims. [*28] For the moment, no one really knows why some species

have two separate systems for smelling. Nor is it entirely clear why most animals have another distinct chemical sense. I'm talking, of course, about taste.

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EVERY APRIL, THE Association for Chemoreception Sciences holds its annual meeting in Florida, and, per tradition, scientists who study smell square off against those who study taste in a heated softball game. "Smell usually wins," smell scientist Leslie Vosshall tells me, "because the field is vastly larger. It's like four or five to one." Like smell, taste—or gustation, in the fancy scientific parlance—is a means of detecting chemicals in the environment. But beyond that, the two senses are distinct. Put your nose next to vanilla oil, and you'll inhale a pleasing odor; drop that same oil on your tongue, and you'll likely flinch in disgust.

The difference between smell and taste is surprisingly complicated. You might reasonably say that animals smell with noses and taste with tongues, but snakes use their tongues to collect odors, and other animals (which we'll meet shortly) taste with unusual body parts. You could also argue (and many scientists do) that we smell molecules that drift through the air, but taste those that stay in liquid or solid form. Smell works at a distance; taste works through contact. That's a better distinction, but it has several problems. First, the receptors that are responsible for recognizing smells are always covered in a thin layer of liquid, so odorant molecules must first dissolve to be detected. So smell—like taste—always involves a liquid step and always involves close contact even if those smells have traveled from afar. Second, as we've seen, ants and other insects can smell by contact, using their antennae to pick

up pheromones that are too heavy to go airborne. Third, fish can smell even though everything they're smelling is dissolved in water. For creatures like these that are constantly immersed in liquid, the distinction between taste and smell can be so confusing that one neuroscientist just told me, "I avoid thinking about it."

But John Caprio, a physiologist who studies catfish, says the difference between smell and taste couldn't be clearer. Taste is reflexive and innate, while smell is not.[*29] From birth, we recoil from bitter substances, and while we can learn to override those responses and appreciate beer, coffee, or dark chocolate, the fact remains that there's something instinctive to override. Odors, by contrast, "don't carry meaning until you associate them with experiences," Caprio says. Human infants aren't disgusted by the smell of sweat or poop until they get older. Adults vary so much in their olfactory likes and dislikes that when the U.S. Army tried to develop a stink bomb for crowd control purposes, they couldn't find a smell that was universally disgusting to all cultures. Even animal pheromones, which are traditionally thought to trigger hardwired responses, are surprisingly flexible in their effects, which can be sculpted through experience.

Taste, then, is the simpler sense. As we've seen, smell covers a practically infinite selection of molecules with an indescribably vast range of characteristics, which the nervous system represents through a combinatorial code so fiendish that scientists have barely begun to crack it. Taste, by contrast, boils down to just five basic qualities in humans—salt, sweet, bitter, sour, and umami (savory)—and perhaps a few more in other animals, which are detected through a small number of receptors. And while smell can be put to complex uses—navigating the open oceans,

finding prey, and coordinating herds or colonies—taste is almost always used to make binary decisions about food. Yes or no? Good or bad? Consume or spit?

It's ironic that we associate taste with connoisseurship, subtlety, and fine discrimination when it is among the coarsest of senses. Even our ability to taste bitter, which warns us of hundreds of potentially toxic compounds, isn't built to *distinguish* between them. There's only one sensation of bitter because you don't need to know which bitter thing you're tasting—you just need to know to stop tasting it. Taste is mostly a final check before consumption: Should I eat this? That's why snakes barely bother with taste. With their flickering tongues, they can make decisions about whether something is worth eating through *smell* well before their mouths make contact.[*30] It's almost unheard of for a snake to strike a prey animal and then spit it out. (We tend to wrongly equate taste with flavor, when the latter is more dominated by smell. That's why food seems bland when you have a cold: Its taste is the same, but the flavor dims because you can't smell it.)

Reptiles, birds, and mammals taste with their tongues. Other animals aren't so restricted. If you're very small, food isn't just something you put in your mouth, but something you can walk upon. As such, most insects can taste with their feet and legs. Bees can detect the sweetness of nectar just by standing on a flower. Flies can taste the apple you're about to eat by landing on it. Parasitic wasps can use taste sensors on the tips of their stings to carefully implant their eggs in the bodies of other insects. One species can even taste the difference between hosts that have already been parasitized by other wasps and those that are currently vacant.[*31]

If a mosquito lands on a human arm, “it’s a delight of the senses,” says Leslie Vosshall. “Human skin has a taste to it, which gives them more confirmation that they made it to the right place.” But if that arm is covered with bitter-tasting DEET, the receptors on their feet force them to take off before they get a chance to bite. Vosshall has videos in which a mosquito lands on a gloved hand and walks over to a small patch of exposed but DEET-covered skin. Its leg touches the skin, and immediately withdraws. It circles, tries again, and retreats again. “It’s poignant,” she tells me, in a strange display of sympathy for a mosquito. “It’s also really psychedelic. We have no idea what it’d be like to taste with our fingers.” Insects can taste with other body parts, too, which expands the uses to which they can put this typically limited sense. Some can find good sites for laying their eggs using taste receptors on their egg-laying tubes. Some have taste receptors on their wings, which might alert them to traces of food as they fly. Flies will start grooming themselves if they taste the presence of bacteria on their wings. Even decapitated flies will do this.

The most extensive sense of taste in nature surely belongs to catfish. These fish are swimming tongues. They have taste buds spread all over their scale-free bodies, from the tips of their whisker-like barbels to their tails. There’s hardly a place you can touch a catfish without brushing thousands of taste buds. If you lick one of them, you’ll both simultaneously taste each other.[*32] “If I were a catfish, I’d love to jump into a vat of chocolate,” John Caprio tells me. “You could taste it with your butt.” With their body-wide buds, catfish have turned taste into an omnidirectional sense—albeit one that’s still devoted to evaluating food. They eat meat, and if you put a piece anywhere on their skin (or add meat juices to the water

around them), they'll turn and snap at the right place. They're exquisitely sensitive to amino acids—the building blocks of proteins and flesh.[*33] They aren't great at detecting sugars, though: Unfortunately for Caprio, his chocolate fantasy would be underwhelming.

This inability to sense sugar and other classic tastes is surprisingly common, and varies according to an animal's diet. Cats, spotted hyenas, and many other mammals that eat meat and nothing else similarly lack a sweet tooth. Vampire bats, which drink only blood, have also lost their taste for sweetness, and for umami. Pandas have no need to sense umami either, since they only eat bamboo, but they gained an expanded set of bitter-sensing genes to warn them of the myriad possible toxins in their mouthfuls.[*34] Other leaf-eating specialists, like koalas, have also gained more bitter detectors, while mammals that swallow their prey whole, including sea lions and dolphins, have lost most of theirs. Repeatedly and predictably, the gustatory Umwelten of animals have expanded and contracted to make sense of the foods they most often encounter. And sometimes those changes altered their destinies.

Like cats and other modern carnivores, small predatory dinosaurs probably lost the ability to taste sugar. They passed their restricted palate on to their descendants, the birds, many of which still have no sense for sweetness. Songbirds—the vocal and hugely successful group that includes robins, jays, cardinals, tits, sparrows, finches, and starlings—are an exception. In 2014, evolutionary biologist Maude Baldwin showed that some of the earliest songbirds regained their sweet tooth by tweaking a taste receptor that normally senses umami into one that also senses sugar. This change occurred in Australia, a land whose plants produce so much sugar that its flowers overflow with

nectar and its eucalyptus trees exude a syrupy substance from their bark. Perhaps these abundant sources of energy allowed the newly sweet-toothed songbirds to thrive in Australia, to endure marathon migrations to other continents, to find nectar-rich flowers wherever they arrived, and to diversify into a massive dynasty that now includes half the world's bird species. This story is unproven but nonetheless beguiling. It's possible that if a random Australian bird hadn't expanded its Umwelt tens of millions of years ago, none of us would be waking up to the melodic sounds of birdsong today.[*35]

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YOU CAN SPLIT the senses into different groups depending on the stimuli that they detect. Smell, its vomeronasal variant, and taste are *chemical senses,* which detect the presence of molecules. They are ancient, universal, and seem to sit apart from the others, which is partly why I chose them as the first stop on our journey. But they aren't entirely distinct. On closer inspection, they share common ground with at least one other sense, in an unexpected way.

At the start of this chapter, we saw that dogs and other animals detect smells using proteins called odorant receptors. These are part of a much larger group of proteins called G-protein-coupled receptors, or GPCRs. Ignore the convoluted name; it doesn't matter. What matters is that they are chemical sensors. They sit on the surface of cells, grabbing specific molecules that float past. Through their actions, cells can detect and react to the substances around them. This process is temporary: After the GPCRs are done, they either release or destroy the molecules that they've grabbed. But one group of them

bucks this trend: opsins. They are special because they keep hold of their target molecules, and because those molecules absorb light. This is the entire basis of vision. This is how all animals see—using light-sensitive proteins that are actually modified chemical sensors.

In a way, we see by smelling light.

SKIP NOTES

*1 In the official parlance, an odorant is the molecule itself, and an odor is the sensation that said molecule produces; isoamyl acetate, an odorant, has the odor of bananas.

*2 It's no coincidence that I'm drawn to Finn's eyes. Dogs have a facial muscle that can raise their inner eyebrows, giving them a soulful, plaintive expression. This muscle doesn't exist in wolves. It's the result of centuries of domestication, in which dog faces were inadvertently reshaped to look a bit more like ours. Those faces are now easier to read, and better at triggering a nurturing response.

*3 I've deliberately avoided putting hard numbers on the scale of these differences. It is easy to find estimates, and very hard to find primary sources for them; after an hours-long search that included a scientific paper that sourced a factoid to a book in the For Dummies series, I fell into an existential void and questioned the very nature of knowledge. Regardless, the differences are there, and they're substantial; it's only a question of exactly how substantial they are.

*4 In one study, two dogs could detect amyl acetate—think bananas—at just 1 or 2 parts per trillion, which would make them 10,000 to 100,000 times better than humans. But it also makes them 30 to 20,000 times better than six beagles that were tested on the same chemical 26 years earlier, using different methods.

*5 I can think of one exception: Some marine worms release glowing "bombs" full of luminescent chemicals, whose persistent light distracts predators from the escaping worms.

*6 Leopard urine smells of popcorn. Yellow ants smell of lemons. Depending on the species, stressed frogs can smell of peanut butter, curry, or cashew nuts, according to scientists who painstakingly sniffed 131 species and won an Ig Nobel Prize for their efforts. Crested auklets—comical seabirds that have tufted heads—roost in massive colonies that, quite delightfully, smell of tangerines.

*7 One possible exception is the puff adder, a venomous African snake. It sits in ambush for weeks at a time, and protects itself by visually blending into its environment. But somehow, it seems to blend in chemically, too. In 2015, Ashadee Kay Miller found that keen-nosed animals, including dogs, mongooses, and meerkats, can't detect a puff adder, even when they walk over one. Dogs can detect the scent of shed skin, but for reasons that no one understands, the living snakes are undetectable to their noses.

*8 Scientists fall prey to this, too. When Horowitz tallied every study of dog behavior published in the last decade, she found that only 4 percent focused on smell. Just 17 percent described the odor environment in which experiments were done—including airflow, temperature, humidity, or the previous presence of people or food. It's as if vision researchers hadn't thought to mention if their laboratory lights were on or not.

*9 At the Oscars ceremony in 2021, a journalist asked South Korean actor Yuh-Jung Youn what Brad Pitt smells like. Youn replied, "I didn't smell him! I'm not a dog!"

*10 The olfactory bulb might not even be necessary for smell. In 2019, Tali Weiss identified several women who seem to lack this structure altogether and could smell just fine. How they do it is anyone's guess.

*11 The binturong is a black, shaggy, 2-meter-long creature that looks like a cross between a cat, weasel, and bear. It's also known as a bearcat, and makes a cameo appearance in my first book, *I Contain Multitudes*.

*12 Unless you actually stuck your nose over some benzaldehyde, you couldn't guess that it smells like almonds. If you saw dimethyl sulfide drawn on a page, you couldn't foresee that it carries the scent of the sea. Even similar molecules can produce immensely different smells. Heptanol, with a backbone of seven carbon atoms, smells green and leafy. Add another carbon atom to the chain and you get octanol, which smells more like citrus. Carvone exists in two forms that contain exactly the same atoms but are mirror images of each other: One smells of caraway seeds and the other of spearmint. Mixtures are even more confusing. When mixed, some pairs of odors still smell distinct,

while others produce a third smell that's unlike the two parents. Meanwhile, perfumes that contain hundreds of chemicals don't smell any more complex than individual odorants, and people typically struggle to name more than three ingredients in a blend. Noam Sobel, a neurobiologist who studies olfaction, has come closer than anyone else to wrangling this complexity. While I was writing this book, he and his team developed a measure that analyzes 21 features of odorant molecules and collapses these into a single number. The closer this smell metric is for any two molecules, the more similar their odors. This isn't quite the same as predicting scent from structure, but it's the next best thing—predicting scent from similarity to other scents.

*13 The terminology is confusing. In sensory biology, the word *receptor* is usually used to describe a sensory cell, like a photoreceptor or a chemoreceptor. In this case, the odorant receptors are proteins on the surface of those cells. Don't blame me; I didn't make the rules.

*14 One widely popularized theory, which says that smells are encoded in the vibrations of different molecules, has been thoroughly debunked.

*15 Human pheromones likely exist, but finding them is a chore. In animals, researchers typically look for stereotyped behaviors or physiological reactions that reveal the reaction to a pheromone—a flaring of the lips, a fluttering of antennae, or a rise in testosterone. Humans are so annoyingly varied and complex that few of our actions fit the bill. Some researchers once suspected that women synchronize their menstrual cycles because of some unidentified pheromone, but such synchronicity is itself a myth. Others now think that breasts might release a pheromone that prompts babies to suckle, but again, no chemical has been isolated.

*16 In September 2020, I noted that the army ant death spiral was the perfect metaphor for the United States' response to the COVID-19 pandemic: "The ants can sense no picture bigger than what's immediately ahead. They have no coordinating force to guide them to safety. They are imprisoned by a wall of their own instincts."

*17 A word of caution: It is dangerous to assess an animal's sensory abilities by counting its genes. Dogs have twice the number of working odorant receptor genes as humans, but that doesn't mean that their sense of smell is twice as good.

*18 There's precedent for this. Back in 1874, the Swiss scientist Auguste Forel showed that an ant's antennae are its main organs of smell. When he removed

those antennae, ants wouldn't build their nests, care for their young, or attack interlopers from other colonies.

*19 Horowitz thinks that the dogs might just not have been motivated to do it.

*20 Given that elephants live in matriarchal societies that are led by females, it's fitting that the study of elephant senses has been led by women: Bets Rasmussen for olfaction; Katy Payne, Joyce Poole, and Cynthia Moss for hearing; and Caitlin O'Connell for seismic senses. We'll meet the others in later chapters.

*21 Arthur Hasler confirmed this ability in the 1950s after having his own olfactory epiphany. While hiking near a waterfall, the familiar smells brought back long-buried childhood memories, and he wondered if migrating salmon experience something similar.

*22 Ornithologist Kenneth Stager ran much better versions of Audubon's studies and showed that turkey vultures do indeed home in on the scent of hidden carcasses. He also learned that an oil company had begun tracking leaks in its pipelines by adding ethyl mercaptan—a gas that smells of farts and decay—and scanning the skies for circling vultures. Intrigued, Stager fashioned his own mercaptan dispenser and deployed it at various sites in California. Whenever he did, vultures arrived. Audubon was wrong: Turkey vultures not only can smell, but can smell well enough to detect the faintest plumes of odorants from miles overhead.

*23 Birds evolved from the same group of small, predatory dinosaurs that included celebrities like *Velociraptor*. By scanning the skulls of these animals, paleontologist Darla Zelenitsky showed that they had large olfactory bulbs for their size—as did larger cousins like *Tyrannosaurus*. These dinosaurs likely used their sense of smell to hunt, and birds are the modern inheritors of that ancient Umwelt.

*24 Tubenoses aren't the only animals that track DMS. Penguins, reef fish, and sea turtles can all detect the chemical, and are all drawn to it.

*25 Tracking such plumes is harder than following a straight line of sight. A bird's best option is to fly across the wind to maximize its chances of blundering into a stray odor molecule, and then follow it upwind on a zigzagging path. That's how male moths find the pheromones released by their females, and it's how albatrosses find the odors released by their prey. Henri Weimerskirch fitted wandering albatrosses—the birds with the world's

greatest wingspan—with GPS loggers to track their whereabouts and stomach temperature recorders to log when they ate. By analyzing that data, Gabrielle Nevitt shows that the birds use zigzagging, smell-tracking flights to capture at least half of their food.

*26 For the longest time, researchers have claimed that the tongue delivers chemicals to the snake's vomeronasal organ, also known as Jacobson's organ, by threading its tips through two holes in the roof of a snake's mouth. This is a myth. X-ray movies show that they do nothing of the sort, and the tongue simply nestles into the roof of the mouth. But to Schwenk's eternal annoyance, the misconception still persists and abounds in textbooks.

*27 Rulon Clark, whom we'll meet in a later chapter, showed that even inexperienced lab-born rattlesnakes can distinguish the smells of favored prey like chipmunks and white-footed mice from those of unfamiliar lab rats. He also found, rather sinisterly, that rosy boas are specifically drawn to the odors of female mice who have litters of young.

*28 It's often mythologized as a specialized pheromone detector, but that can't be true, since it also responds to other odorants, while the main smell system also picks up pheromones. It might detect molecules too heavy to float through the airways of the main olfactory system, but this idea hasn't been adequately tested. It might control instinctive responses to smells while the main system governs responses that animals learn through experience; this idea hasn't been thoroughly tested, either.

*29 The two senses use different receptors and different neurons, which connect to different parts of the brain. In vertebrates, the taste system is mostly wired to the hindbrain, which controls basic vital functions. The smell system is hooked up to the forebrain, which controls more advanced abilities like learning.

*30 Schwenk thinks that's because snakes eat infrequently, but in bulk. They'll often tackle much larger prey, and then remodel their innards to digest their meals. When a python swallows a pig or deer, its guts and liver double in size and its heart swells by 40 percent over just a few days. For them, every meal soaks up a lot of energy, and they need to know as early as possible whether to pay that cost.

*31 The stinger of a parasitic wasp is like a Swiss army knife. Aside from taste sensors, it can also carry smell sensors, touch sensors, and bits of metal. It's a drill, a nose, a tongue, and a hand.

*32 Some catfish have venomous spines and (as we'll discover in a later chapter) others can create electricity, so animal welfare issues aside, I would highly recommend not licking one, except as part of a thought experiment.

*33 Amino acids come in two forms that are mirror images of each other, called L and D. Nature relies primarily on the L forms, and the D forms are incredibly rare in animals. So in the mid-1990s, when Caprio tested the marine hardhead catfish, he was shocked to learn that almost half its taste buds react to D-amino acids. "I thought that's got to be a mistake," he says. "Where are there D-amino acids in the environment that would be important to catfish?" He eventually learned that several marine worms and clams can flip L-amino acids into their mirrored D opposites. Scientists only discovered that marine animals make D-amino acids in the 1970s. "The catfish knew it hundreds of millions of years ago," Caprio says.

*34 Remember, though, that taste is more about coarse detection than fine discrimination: Compared to a dog, a panda might recognize more things as being bitter, but it likely experiences those things in the same consistent way.

*35 Baldwin also showed that hummingbirds repurposed their umami receptor into a sugar one. They changed the same gene as the songbirds, but independently, and in an almost completely different way. She tells me that in some species, the altered receptor can still detect umami, which means "they may not be able to distinguish between sweet and savory." Imagine being unable to tell the difference between soy sauce and apple juice.

2.

Endless Ways of Seeing

Light

I AM STARING AT A JUMPING spider, and even though its body is pointing away from me, it is staring back. Four pairs of eyes encircle its turret-like head, two pointing forward and two pointing sideways and backward. The spider has close to wraparound vision, and its only blind spot is immediately behind it. When I waggle my finger in its five o'clock, it sees my vibrating digit and turns around. As I move the finger, the spider follows. Jumping spiders "are the only spiders that will turn and look at you routinely," says Elizabeth Jakob, whose lab in Amherst, Massachusetts, I am currently visiting. "A lot of spiders spend a lot of time just sitting motionless on a web and waiting for something to happen. But these are active."

Humans are such a visual species that those of us with sight instinctively equate active eyes with an active intellect. In their flitting, darting movements, we see another curious mind investigating the world. In the case of jumping spiders, this is not unwarranted anthropomorphism. Despite their poppy-seed-sized brains, they really are surprisingly smart.[*1] The *Portia* species are famed for planning out strategic routes when stalking prey, or flexibly switching between sophisticated hunting tactics. The bold jumping spiders (*Phidippus audax*) that Jakob studies are less ingenious, but she still houses them in the company of stimulating objects—the kind of environmental enrichment that zookeepers might provide for captive

mammals. Some have brightly colored sticks in their terraria. One individual, I note, has a red Lego brick. We joke about what it might build when our backs are turned.

Barely bigger than my smallest fingernail, the bold jumping spider is mostly black, except for white fuzz on its knees and vibrant turquoise splotches on the appendages that hold its fangs. It is unexpectedly cute. Its stocky body, short limbs, large head, and wide eyes are all rather childlike, and stir the same deep psychological bias that makes babies and puppies adorable. But its proportions didn't evolve to engender empathy. The short limbs power great leaps: Unlike other spiders that sit in ambush, jumping spiders stalk and pounce upon their prey. And unlike other spiders that mostly sense the world through vibrations and touch, jumping spiders rely on vision. That's why the eight eyes occupy up to half the volume of their large heads. They are the spiders whose Umwelten are closest to ours. In that similarity, I find affinity. I watch the spider, and it watches me back, two starkly different species connected by our dominant sense.

The late British neurobiologist Mike Land, described to me by one of his colleagues as "the god of eyes," pioneered the study of jumping spider vision. In 1968, he developed an ophthalmoscope for spiders, which he could use to observe the creatures' retinas as they, in turn, gazed at images. Jakob and her colleagues have refined Land's design; during my visit, they've placed a jumping spider in their device, which is currently trained upon the creature's central eyes. These point straight ahead and are the largest of the four pairs. They are also the sharpest. Despite being just a few millimeters long, they can see as clearly as the eyes of pigeons, elephants, or small dogs. Each eye is a long tube, with a lens at the front and a retina at the back.

[*2] The lens is fixed in place, but the spider can look around by swiveling the rest of the tube inside its head. (Imagine gripping a flashlight by its head, and then aiming its beam by moving the tube.)[*3] The female spider in the eye tracker is doing exactly that. Her body is still. Her eyes look still, too. But on the monitor, we can see that her retinas are moving. “She’s really looking around,” Jakob says.

For reasons that no one fully understands, the retinas of her central eyes are shaped like boomerangs. At first, on Jakob’s screen, they seem separate (> <). But when she shows the spider a black square, the two retinas converge upon it, forming crosshairs (><). As the square moves, the retinas follow. After a while, though, the spider loses interest, and the retinas diverge. Jakob replaces the square with the silhouette of a cricket, and the retinas converge again. This time, they dance over the image, flitting between the antennae, body, and legs with the same jerky hops that our eyes make when taking in a scene. The retinas also rotate together, twisting clockwise and anticlockwise, perhaps because the spider is searching for specific angles that might help it identify what it’s looking at. Mike Land once wrote that it is “ an exhilarating but very weird experience to look into the moving eyes of another sentient creature, particularly one so far removed in its evolution from oneself.” I couldn’t agree more. At least 730 million years of evolution separate humans from jumping spiders, and it is hard to interpret the behavior of such a different creature. But on Jakob’s monitor, I can watch a spider paying attention and losing interest. I can observe it observing. By watching its gaze, I can get as close as possible to glimpsing its mind. And, despite many

similarities, I can see just how different its vision is from mine.

For a start, it has more eyes. The central pair may be sharp and mobile, but their field of view is very narrow. If they were all the spider had, its vision would be like two flashlights sweeping around a dark room. The secondary eyes on either side of the central pair compensate for this shortcoming with a much broader field of view. And though they are themselves immobile, they are highly sensitive to motion. If a fly buzzes in front of the spider, the secondary eyes spot it and tell the central eyes where to look. And here's the truly bizarre part: If the secondary eyes are covered, the spider cannot track moving objects.

I find this almost impossible to imagine. As I write these words, I am focusing the sharpest parts of my eyes on the letters appearing on my screen. Meanwhile, in my peripheral vision, I can see the black shape of Typo, my corgi puppy, as he prowls around my living room in search of trouble. These tasks—sharp vision and motion detection—feel inseparable. And yet jumping spiders have separated them so thoroughly that they exist within *different sets of eyes*. The central ones recognize patterns and shapes and see in color. The secondary ones track movements and redirect attention. Different eyes for different tasks, and each set has its own distinct connections to the spider's brain.[*4] Jumping spiders remind us that we share a visual reality with other sighted creatures, but we experience it in utterly different ways. "We don't have to look to aliens from other planets," Jakob tells me. "We have animals that have a completely different interpretation of what the world is right next to us."

Humans have two eyes. They're on our heads. They're equally sized. They face forward. None of these traits is the

norm, and a cursory glance at the rest of the animal kingdom reveals that eyes can be as varied as the creatures that own them. Eyes can come in eights or hundreds. The eyes of the giant squid are as big as soccer balls; those of fairy wasps are the size of an amoeba's nucleus. Squid, jumping spiders, and humans have all independently evolved camera-like eyes, in which a single lens focuses light onto a single retina. Insects and crustaceans have compound eyes, which consist of many separate light-gathering units (or ommatidia). Animal eyes can be bifocal or asymmetric. They can have lenses made of protein or rock. They can appear on mouths, arms, and armor. They can accomplish all the tasks our eyes can perform, or just a few of them.

This smorgasbord of eyes brings with it a dizzying medley of visual Umwelten. Animals might see crisp detail at a distance, or nothing more than blurry blotches of light and shade. They might see perfectly well in what we'd call darkness, or go instantly blind in what we'd call brightness. They might see in what we'd deem slow motion or time-lapse. They might see in two directions at once, or in every direction at once. Their vision might get more or less sensitive over the span of a single day. Their Umwelt might change as they get older. Jakob's colleague Nate Morehouse has shown that jumping spiders are born with their lifetime's supply of light-detecting cells, which get bigger and more sensitive with age. "Things would get brighter and brighter," Morehouse tells me. For a jumping spider, getting older "is like watching the sun rising."

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SONKE JOHNSEN OPENS his book *The Optics of Life* by noting that vision "is about light, so perhaps we should start with what light is." And then, with admirable candor: "I have no idea." Though it surrounds us almost constantly, light's true nature is not intuitive. Physicists contend that it exists both as an electromagnetic wave and as particles of energy known as photons. The specifics of this dual nature needn't concern us. What matters is that neither guise is something living things should obviously be able to detect. From a biological perspective, perhaps the most wondrous thing about light is that we can sense it at all.

Look inside the eyes of a jumping spider, a human, or any other animal, and you'll find light-detecting cells called photoreceptors. These cells might vary dramatically from one species to another, but they share a universal feature: They contain proteins called opsins. Every animal that sees does so with opsins, which work by tightly embracing a partner molecule called a chromophore, usually derived from vitamin A. The chromophore can absorb the energy from a single photon of light. When it does, it instantly snaps into a different shape, and its contortions force its opsin partner to reshape itself, too. The opsin's transformation then sets off a chemical chain reaction that ends with an electrical signal traveling down a neuron. This is how light is sensed. Think of the chromophore as a car key and the opsin as an ignition switch. The two fit together, light turns the key, and the engine of vision whirs into life.

There are thousands of different animal opsins, but they are all related.[*5] Their unity creates a paradox. If all vision relies on the same proteins, and if those proteins all detect light, then why are eyes so diverse? The answer lies in light's distinct properties. Since most light on Earth comes

from the sun, its presence can hint at temperature, time of day, or depth of water. It reflects off objects, revealing enemies, mates, and shelter. It travels in straight lines and is blocked by solid obstacles, creating telltale features like shadows and silhouettes. It covers Earth-scale distances almost instantaneously, offering a fast and far-ranging source of information. Vision is diverse because light is informative in a multitude of ways, and animals sense it for myriad reasons.

The biologist Dan-Eric Nilsson says that eyes evolve through four stages of increasing complexity. The first just involves photoreceptors—cells that do little more than detect the presence of light. The hydra, a relative of jellyfish, uses photoreceptors to ensure that its stings fire more readily in dim light; perhaps it does this to save those stings for nighttime hours, when its prey is more common, or to deploy them when it senses the shadow of a passing target. Olive sea snakes have photoreceptors at the tips of their tails, which they will pull away from sources of light. Octopuses, cuttlefish, and other cephalopods have photoreceptors dotted throughout their skin, which might help to control their amazing color-changing abilities.[*6]

In the second stage, photoreceptors gain shade—a dark pigment or some other barrier that blocks the light coming in from certain angles. Shaded photoreceptors can not only detect light's presence but also infer its direction. These structures are still so simple that many scientists don't even regard them as genuine eyes, but they are useful to their owners nonetheless. They can also show up anywhere. The Japanese yellow swallowtail butterfly has photoreceptors on its genitals. A male uses these cells to guide his penis over a female's vagina, and a female uses

them to position her egg-laying tube over the surface of a plant.

In the third of Nilsson's stages, shaded photoreceptors cluster into groups. Their owners can now knit together information about light from different directions to produce images of the world around them. For many scientists, this is the point when light detection becomes actual vision, when simple photoreceptors become bona fide eyes, and when animals can truly be said to see.[*7] At first, their vision is blurry and grainy, suitable only for crude tasks like finding shelter or spotting looming shapes. But with the addition of focusing elements like lenses, their view sharpens, and their Umwelt fills with rich visual detail. High-resolution vision is the fourth of Nilsson's stages. When it first appeared, it would have intensified the interactions between animals. Conflicts and courtships could play out over distances longer than touch or taste would allow and at speeds too fast for smell. Predators could now spot their prey from afar, and vice versa. Chases ensued. Animals became bigger, faster, and more mobile. Defensive armor, spines, and shells evolved. The rise of high-resolution vision might explain why, around 541 million years ago, the animal kingdom dramatically diversified, giving rise to the major groups that exist today. This flurry of evolutionary innovation is called the Cambrian explosion, and stage-four eyes might have been one of the sparks that ignited it.

Nilsson's four-stage model addresses a concern of Charles Darwin, who was unsure how complex modern eyes could have evolved. " To suppose that the eye, with all its inimitable contrivances…could have been formed by natural selection, seems, I freely confess, absurd in the highest possible degree," he wrote in *The Origin of*

Species. “Yet reason tells me, that if numerous gradations from a perfect and complex eye to one very imperfect and simple, each grade being useful to its possessor, can be shown to exist…then the difficulty of believing that a perfect and complex eye could be formed by natural selection, though insuperable by our imagination, can hardly be considered real.” The gradations Darwin imagined do indeed exist: Animals have every conceivable intermediate from simple photoreceptors to sharp eyes. And different animal groups have repeatedly and independently evolved diverse eyes using the same opsin building blocks. The jellyfish alone have evolved stage-two eyes at least nine times, and stage-three eyes at least twice. Eyes, far from being a blow to evolutionary theory, have proved to be one of its finest exemplars.[*8]

Darwin was wrong, though, in calling complex eyes perfect and simpler ones imperfect. Stage-four eyes are not some Platonic ideal that evolution was striving toward. The simpler eyes that preceded them are all still around and are well suited to the needs of their owners. “Eyes didn’t evolve from poor to perfect,” Nilsson emphasizes. “They evolved from performing a few simple tasks perfectly to performing many complex tasks excellently.” As we saw in the introduction, a starfish has eyes on the tips of its five arms. These eyes can’t see color, detail, or fast movements, but they don’t have to. They only have to detect large objects, so that the starfish can slowly amble back toward the safety of a coral reef. A starfish has no need for an eagle’s acute eye, or even a jumping spider’s. It sees what it needs to.[*9] The first step to understanding another animal’s Umwelt is to understand what it uses its senses *for*.

Primates, for example, probably evolved big, sharp eyes to capture tree-dwelling insects sitting on branches. We humans have inherited that acute vision, which sighted people now use to guide their dexterous fingers, to read symbols that they imbue with meaning, and to assess the cues hidden in subtle facial expressions. Our eyes suit our needs. They also give us a singular Umwelt that most other animals do not share.

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IN 2012, WHEN Amanda Melin, a scientist who studies animal vision, met Tim Caro, a scientist who studies animal patterns, their conversation naturally turned to zebras.

Caro had become the latest in a long line of biologists to wonder why zebras have such conspicuous black-and-white patterns. One of the earliest and most prominent hypotheses, he told Melin, was that the stripes counterintuitively act as camouflage. They mess with the eyes of predators like lions and hyenas by breaking up the zebra's outline, or by helping it to blend in among the vertical trunks of trees, or by causing a confusing blur when it runs. Melin was dubious. "I had a look on my face," she recalls. "I said, 'I think most of the carnivores are hunting at night, and their visual acuity is going to be so much worse than humans'. They probably can't see the stripes.' And Tim went, '*What?*' "

Humans outshine almost every other animal at resolving detail. Our exceptionally sharp vision, Melin realized, gives us a rarefied view of a zebra's stripes. She and Caro calculated that on a bright day, people with excellent eyesight can distinguish the black-and-white bands from 200 yards away. Lions can only do so at 90 yards and

hyenas at 50 yards. And those distances roughly halve at dawn and dusk, when these predators are more likely to hunt. Melin was right: The stripes can't possibly act as camouflage because predators can only make them out at close range, by which point they can almost certainly hear and smell the zebra. At most distances, the stripes would just fuse together into a uniform gray. To a hunting lion, a zebra mostly looks like a donkey.[*10]

An animal's visual acuity is measured in cycles per degree—a concept that, by happy coincidence, you can think of in terms of zebra stripes. Stretch out your arm and give a thumbs-up. Your nail represents roughly 1 degree of visual space, out of the 360 degrees that surround you. You should be able to paint 60 to 70 pairs of thin black-and-white stripes on that nail and still be able to tell them apart. A human's visual acuity, then, is somewhere between 60 and 70 cycles per degree, or cpd. The current record, at 138 cycles per degree, belongs to the wedge-tailed eagle of Australia.[*11] Its photoreceptors are some of the narrowest in the animal kingdom, which allows them to be densely packed within the eagle's retinas. With these svelte cells, the eagle effectively sees the world on a screen with over twice as many pixels as ours. It can spot a rat from a mile away.

But eagles and other birds of prey are the only animals whose vision is substantially sharper than ours. Sensory biologist Eleanor Caves has been collating visual acuity measurements for hundreds of species, almost all of which are surpassed by humans. Aside from raptors, only other primates come close to our standards. Octopuses (46 cpd), giraffes (27 cpd), horses (25 cpd), and cheetahs (23 cpd) do reasonably well. A lion's acuity is only 13 cpd, just above the 10 cpd threshold at which humans are considered

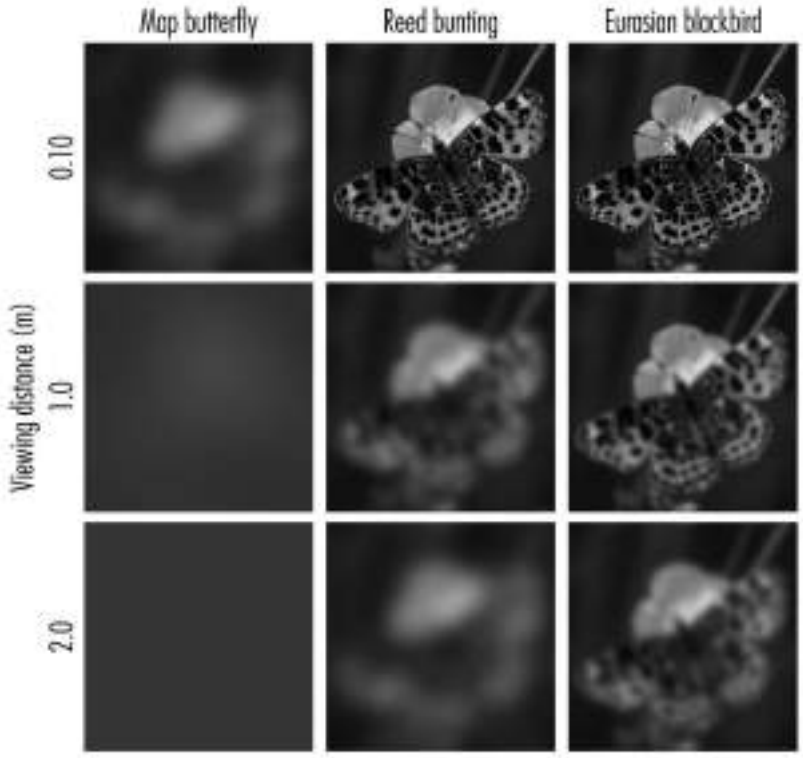
legally blind. Most animals fall below that threshold, including half of all birds (and surprising ones like hummingbirds and barn owls), most fish, and all insects. A honeybee's acuity is just 1 cycle per degree. Your outstretched thumbnail represents roughly one pixel of a bee's visual world, and all the detail within that nail would collapse into a uniform smudge. Around 98 percent of insects have vision that's even coarser. "Humans are weird," Caves tells me. "We're not the pinnacle of any sensory modality, but we're rocking it with visual acuity." And paradoxically, our sharp vision muddies our appreciation of other Umwelten, because "we assume that if we can see it, they can, and that if it's eye-catching to us, it's grabbing their attention," says Caves. "That's not the case."

Caves fell prey to this perceptual bias herself. She studies cleaner shrimps, which helpfully exfoliate fish of parasites and dead skin. "They're cleaning colorful coral reef fish, and they're colorful themselves, so I thought they'd have reasonable vision," Caves tells me. They do not. Their fish clients can see the vibrant blue spots on their bodies, and the bright white antennae that they wave about, but they themselves cannot. A cleaner shrimp's beautiful patterns are not part of a cleaner shrimp's Umwelt, even at very close range. "They probably can't even see their own antennae," Caves says.

Many butterflies also have intricate patterns on their wings, which might warn predators that these insects are toxic. Some scientists have suggested that the butterflies might recognize each other from these patterns, but that's unlikely when their vision isn't sharp enough. A blackbird can see the black spots that freckle the orange wings of a map butterfly, but another map butterfly probably just sees

an orange blur. We've always looked at butterflies, cleaner shrimps, and zebras through the wrong eyes—ours.

Why, then, since animals are so frequently adorned with elaborate patterns, aren't sharp eyes more common? In some cases it's because eyes are constrained by their past. The curse of low resolution is baked into the structure of a compound eye, and having started off with eyes of this kind, insects and crustaceans are now stuck. Robber flies manage 3.7 cycles per degree, but that's about the limit. For a fly's eye to be as sharp as a human's, it would have to be a meter wide.



A map butterfly as viewed through the eyes of different species from varying distances

Acute eyes also come with a hefty drawback. As the wedge-tailed eagle demonstrates, animals can achieve sharper vision by having smaller and more densely packed

photoreceptors. But each receptor now collects light over a smaller area and is thus less sensitive. These qualities—sensitivity and resolution—seesaw against each other. No eye can excel at both. An eagle might be able to spot a far-off rabbit in broad daylight, but its acuity plummets as the sun sets. (There are no nocturnal eagles.) Conversely, lions and hyenas might not be able to resolve a zebra's stripes at a distance, but their vision is sensitive enough to hunt one at night. They, and many other animals, have prioritized sensitivity over acuity. As ever, eyes evolve to suit the needs of their owners. Some animals simply don't need to see crisp images. And some animals don't need to see images at all.

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DANIEL SPEISER NEVER thought he would spend his career trying to empathize with scallops. When he started graduate school in 2004, he thought about them the same way most people do—"as lumps of meat on a plate," he tells me. But those appetizing pan-seared lumps are merely the muscles that scallops use to close their shells. Look at a full, living scallop, and you'll see a very different animal. And that animal will see you, too. Each half of a scallop's fan-shaped shell has eyes arrayed along its inner edge—dozens in some species, and up to 200 in others. In the bay scallop, the eyes look like neon blueberries. Speiser finds them "funny and horrifying and charming," all at once.

It is strange enough that scallops have eyes when most other bivalves like mussels and oysters do not. It's even stranger that those eyes, as Mike Land showed in the 1960s, are complex. Each one sits at the end of a mobile tentacle. Each has a little pupil: "It's wild and creepy to see

all of them opening and closing at the same time," Speiser says. Light passes through the pupil and hits the back of the scallop's eye, where it is reflected by a curved mirror. The mirror is a precisely tiled array of square crystals that collectively focus light onto the scallop's retinas. That's retinas, plural. There are two per eye, and they are about as different as two animal retinas could be.[*12] Between them, they have thousands of photoreceptors, which gives them enough spatial resolution to detect small objects. "Their optics are really good," Speiser says.[*13]

But *why*? When scallops are threatened, they can swim away, opening and closing their shells like panicked castanets. Beyond these rare moments of action, though, they mostly sit on the seafloor, sieving edible particles from the water. They're "glorified clams," according to Sonke Johnsen. Why do they need such a complicated eye, let alone dozens or hundreds of them? What does a scallop use its vision for? To find out, Speiser ran an experiment that he called Scallop TV. He strapped their shells to small seats, placed them in front of a monitor, and showed them computer-generated movies of small, drifting particles. It was such a ridiculous setup that no one seriously thought that it would work. But it did: If the particles were large enough and moving slowly enough, the scallops opened their shells, as if ready to feed. "It was the craziest thing I've ever seen," Johnsen tells me.

At the time, Speiser thought that scallops must use their eyes to spot potential food. Now he thinks something else is happening. Interspersed between their eyes are tentacles that scallops use to smell molecules in the water. Speiser thinks they use smell to recognize predators like starfish and vision to detect things that are simply worth an investigative sniff. When they opened their shells in

response to Scallop TV, they weren't trying to feed but were seeking to explore. "My guess is that we were seeing scallops being curious," Speiser says.

Speiser suspects that scallop vision works in a very different way than ours. Our brains combine the overlapping information from our two eyes into a single scene. A scallop *could* do the same across a hundred eyes, but that seems unlikely given how crude its brain is. Instead, each eye might simply tell the brain whether it has detected something moving or not. Think of the scallop's brain as a security guard watching a bank of a hundred monitors, each connected to a motion-sensing camera. If the cameras detect something, the guard sends sniffer dogs to investigate. Here's the catch: The cameras may be state-of-the-art, but the images they capture *are not sent to the guard*. All the guard sees on the monitors is a warning light for every camera that has spotted something. If Speiser is right about this bizarre setup, it means that even though each individual scallop eye has good spatial resolution, the animal itself might not have spatial *vision*. It knows when eyes in a certain region of its body have detected something, but it has no visual image of that object. It doesn't experience a movie in its head the same way we do. It sees without scenes.

This kind of vision is probably closer to our sense of touch than anything we experience with our eyes. We don't create a tactile scene of the world, even though we can feel with every part of our skin. Indeed, we largely ignore those sensations until something pokes us (or vice versa). And when we feel something unexpected, our most common reaction is to turn and look at it. Perhaps for a scallop, smell (not vision) is the fine-grained exploration sense and

vision (not touch) is the crude, whole-body detection sense.[*14]

But if that's the case, why does each individual eye have such good resolution? Why do sophisticated components like the mirrors and double retinas exist? Why are there so many eyes when just a few could cover the entire space around the scallop's shell? Why have such good eyes evolved in an animal whose brain can barely handle the information they convey?[*15] No one knows. "Sometimes I feel like I can almost get my mind around it, and extend my empathy into scallops," Speiser tells me. "But a lot of the time I feel lost again."[*16]

Some animals might have the scallop's distributed vision without possessing eyes at all. The brittle star *Ophiomastix wendtii* looks like a skinny, spiny starfish, or perhaps like five centipedes wriggling out of a hockey puck. It doesn't have any obvious eyes, but it clearly sees. It will scuttle away from light, crawl toward shady crevices, and even change color after sunset. In 2018, Lauren Sumner-Rooney showed that the brittle star has thousands of photoreceptors over the full lengths of its sinuous arms. It's as if the entire animal acts as a compound eye.[*17] Weirder still, it's only an eye *during the day*.

When the sun is out, the brittle star expands sacs of pigment in its skin, which give it the deep red of a blood clot. At night, it shrinks these sacs, and becomes pale gray and striped. When expanded, the pigment sacs block light from reaching the photoreceptors at certain angles. This gives each receptor the directionality of a stage-two eye, and it gives the entire animal the spatial vision of a stage-three eye. But when the pigment sacs contract at night, the photoreceptors are fully exposed. Unable to tell the direction of incoming light, their spatial vision no longer

works. “It knows when it’s exposed to light, but doesn’t know how to get away from it,” Sumner-Rooney says.

It’s anyone’s guess what the brittle star itself makes of this change. Unlike a scallop, it doesn’t even have a brain—just a decentralized ring of nerves surrounding its central disc. This ring coordinates the five arms but doesn’t command them; they mostly act on their own. It’s as if the brittle star has the same weird system of cameras as the scallop, but without the security guard. The cameras are just signaling each other. Do they do so across the entire animal? Is each separate arm its own eye? Is each arm a swarm of semi-autonomous eyes that happen to be linked? “It could be something so out there that we haven’t even thought of it yet,” Sumner-Rooney tells me. “Everything we know about animal vision to date relies on having an eye. We’re basing everything on a century’s worth of research on contiguous retinas, with photoreceptors that are close together and grouped. [The brittle star] violates a lot of those assumptions.”

With multitudes of eyes, no heads, and sometimes no brains, brittle stars and scallops all reveal how strange vision can be. “An animal doesn’t have to see a picture to be able to use vision,” Sumner-Rooney says. “But humans are such visually driven creatures that trying to conceive of these completely alien systems is very hard.” It is easier to imagine the visual worlds of more familiar creatures with heads and two eyes. But even then, we might miss what is right in front of us.

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RISING HIGH ON columns of warm air, griffon vultures soar over rolling landscapes in search of food. Since they can

spot carcasses on the ground, they should easily be able to see large obstacles ahead of them. And yet vultures, eagles, and other large raptors often fatally crash into wind turbines. In one Spanish province alone, 342 griffon vultures collided with wind turbines over a 10-year period. How could birds that fly by day and have some of the planet's sharpest eyes fail to avoid structures so large and conspicuous? Graham Martin, who studies bird vision, answered this question by addressing another: Where exactly do vultures look?

In 2012, Martin and his colleagues measured the griffon vulture's visual field—the space around its head that its eyes can cover. They got each bird to rest its beak on a specially fitted holder, and then looked into its eyes from all directions with a visual perimeter. "It's the same device that an optician would use when you get an eye test," Martin told me at the time. "It's just a question of sitting the bird down for half an hour. One tried to grab at me and I did lose a bit of my thumb."

The perimeter revealed that a vulture's visual field covers the space on either side of its head but has large blind spots above and below. When it flies, it tilts its head downward, so its blind spot is now directly ahead of it. This is why vultures crash into wind turbines: While soaring, they aren't looking at what is right in front of them. For most of their history, they never had to. "Vultures would never have encountered an object so high and large in their flight path," Martin says. It might work to turn off the turbines if the birds are near, or to lure the vultures away using ground-based markers. But visual cues on the blades themselves won't work.[*18] (In North America, bald eagles also crash into wind turbines for the same reasons.)

When I think about Martin's study, I'm suddenly and acutely aware of the large space behind my head that I cannot see and that I seldom think about. Humans and other primates are rather odd in having two eyes that point straight ahead. The left eye gets a very similar view to the right, and their visual fields overlap a lot. This arrangement gives us excellent depth perception. It also means we can barely see things to our sides, and we can't see what's behind us without turning our heads. For us, seeing is synonymous with facing, and exploration is achieved through gazing and turning. But most birds (except for owls) tend to have side-facing eyes and don't need to point their heads at something to look at it.

A soaring vulture that's scanning the ground can also see other vultures flying next to it, without having to turn. A heron's visual field covers 180 degrees in the vertical; even when standing upright with its beak pointing straight ahead, it can see fish swimming near its feet. A mallard duck's visual field is completely panoramic, with no blind spot either above or behind it. When sitting on the surface of a lake, a mallard can see the entire sky without moving. When flying, it sees the world simultaneously moving toward it and away from it. We use the phrase "bird's-eye view" to mean any vista seen from on high. But a bird's view is not just an elevated version of a human one. " The human visual world is in front and humans move into it," Martin once wrote. But "the avian world is around and birds move through it."[*19]

Birds also differ from humans in where their vision is sharpest. Many animals have an area in their retinas where their photoreceptors (and the attendant neurons) are densely packed, increasing the resolution of their vision. This region goes by many names. In invertebrates, it's

called an *acute zone*. In vertebrates, it's an *area centralis*. If that area is also inwardly dimpled, as it is in our eyes, it's a *fovea*. For all our sakes (except the vision scientists, to whom I apologize), I'm just going to stick with *acute zone*. In humans, it's a bullseye—a round spot in the center of our visual field. It's what you are training upon these letters as you read them. Most birds also have circular acute zones, but theirs point outward, not forward. If they want to examine objects in detail, they have to look sideways, with just one eye at a time. When a chicken investigates something new, it will swing its head from side to side to look upon it with the acute zone of each eye in turn. "When chickens look at you, you never know what the other eye is doing," says Almut Kelber, a zoologist who studies bird vision. "They must have at least two centers of attention, which is very hard to imagine."

Many birds of prey, like eagles, falcons, and vultures, actually have two acute zones *in each eye*—one that looks forward, and another that looks out at a 45-degree angle. The side-facing one is sharper, and it's the one that many raptors use when hunting. When a peregrine falcon dives after a pigeon, it doesn't plunge straight at its prey. Instead, it flies along a descending spiral. That's the only way it can keep the pigeon within its murderous side-eye, while also pointing its head down and maintaining a streamlined shape.[*20]

The peregrine prefers to use its right eye to track prey. Such preferences are common to birds; when eyes see distinct views, those eyes can be used for distinct tasks. The left half of a chick's brain is specialized for focused attention and categorizing objects; the bird can spot food grains among a bed of pebbles if it uses its right eye (directed by its left brain), but not its left eye. The right

half of the brain deals with the unexpected; many birds use their left eyes (directed by their right brains) to scan for predators, and are quicker to detect a threat when it approaches from the left.

An animal's visual field determines where it can see. Its acute zones determine where it sees *well*. Without considering both traits, we can seriously misinterpret an animal's actions. In a video that went viral on TikTok, a male argus pheasant displayed his dazzling plumage to a female, who seemed to look off to the side. Viewers laughed at her apparent disinterest, not knowing that she was looking right at him with her side-facing visual field. A seal's visual field is more similar to ours but with excellent coverage above its head and poor coverage below, presumably to spot fish silhouetted against the sky. A seal that swims upside down might look relaxed to a human observer, but is actually scanning the seafloor for food.

Cows and other livestock also have a somnolent air because their gaze is so fixed. They rarely turn to look at you in the way another human (or a jumping spider) might. But they also don't need to. Their visual fields wrap almost all the way around their heads and their acute zones are horizontal stripes, giving them a view of the entire horizon at once. The same is true for other animals that live in flat habitats, including rabbits (fields), fiddler crabs (beaches), red kangaroos (deserts), and water striders (the surface of ponds). Except for the occasional aerial predators, *up* and *down* are largely immaterial to them. There is only *across,* in every possible direction. A cow can simultaneously see a farmer approaching it from the front, a collie walking up from behind, and the herdmates at its side. *Looking around,* which is inextricable from our experience of vision,

is actually an unusual activity, which animals do only when they have restricted visual fields and narrow acute zones.

Elephants, hippos, rhinos, whales, and dolphins have two or three acute zones per eye, possibly because they can't quickly turn their heads.[*21] Chameleons don't have to turn because their turret-like eyes can move independently; they can look in front and behind at the same time, or track two targets moving in opposite directions. Other animals are steadier in their gaze. Many male flies focus upward: The large facets at the top of their compound eyes are called love spots, and allow them to detect the silhouettes of females flying overhead. Male mayflies have gone even further: The female-spotting parts of their eyes are so enormous that each eye looks like it is wearing a chef's hat. The fish *Anableps anableps,* which lives at the surface of South American rivers, also partitions its eyes. The top half sticks out of the water and is adapted for air vision, and the bottom half stays below the surface and is adapted for aquatic vision. It's also known as the four-eyed fish.

In the three-dimensional world of the deep ocean, above and below matter as much as in front and behind. Many deep-sea fish like barreleyes and hatchetfish have tubular eyes that point upward, allowing them to see the outlines of other animals silhouetted against the faint downwelling sunlight. The brownsnout spookfish, a kind of barreleye, has amended the upward eye of its kin with a downward-pointing chamber that has its own retina; with these two-part eyes, it can look up and down at the same time. So can the cock-eyed squid, whose left eye is twice the size of its right. It hangs in the water column with the small eye pointing downward to spot bioluminescent flashes and the big eye pointing up to spot silhouettes. Meanwhile, the

deep-sea crustacean *Streetsia challengeri* has fused its eyes into a single horizontal cylinder, which looks like a corn dog. It can see in almost every direction circumferentially—above, below, and to the sides—but not ahead or behind.

It is almost impossible to imagine what it would be like to see like *Streetsia,* or a chameleon, or even a cow. The reverse-facing camera of my smartphone can show me what's going on over my shoulder, but that image still appears in my relentlessly forward-facing visual field. Again, as with the scallops, it helps to think about touch. I can simultaneously feel the sensations on the skin of my scalp, soles, chest, and back. If I concentrate, I can just about imagine what it might be like to fuse the omnidirectional nature of that sensation with the long range of sight. Vision can extend in any direction and every direction. It can envelop and surround. And it can vary in time as well as space. It can fill not just the empty voids around us but also the fleeting gaps between moments.

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THE MEDITERRANEAN IS home to a small, unassuming fly called *Coenosia attenuata*. Just a few millimeters long, with a pale gray body and large red eyes, "it looks like a standard housefly," Paloma Gonzalez-Bellido tells me. In fact, it is a killer. From its perch on a leaf, it will take off in pursuit of fruit flies, fungus gnats, whiteflies, and even other killer flies—"anything that's small enough for them to subdue," Gonzalez-Bellido says. During the chase, it stretches out its legs. As soon as one touches the target, all six clamp shut, forming a cage. Often, it will fly the victim back to its original perch. If you can coax a killer fly to

crawl onto your finger, it will repeatedly launch itself from your digit and return with prey, like a (very tiny) falcon to its falconer. This experience can be unexpectedly magical for a human. It's less so for the prey. While a typical housefly has a proboscis that resembles a sponge on a stick, used for dabbing and sucking at liquids, a killer fly's proboscis is part dagger and part rasp, used for stabbing and scraping flesh. The fly shoves it into its victim and hollows it out while it is still alive. Gonzalez-Bellido has a video in which you can see a killer fly's mouthparts scraping away a fruit fly's eye from the inside, leaving nothing behind but a grid of transparent lenses. Farmers and gardeners frequently introduce this insect into greenhouses to take care of pests, and it has now spread all around the world.

For killer flies, speed is everything. "Their prey can come from anywhere, and the Mediterranean is so dry that it's rare for them to have prey," Gonzalez-Bellido says. They immediately take off after anything that could conceivably be a meal and, once airborne, catch their prey as quickly as possible so that they themselves aren't cannibalized by others of their kind. Their chases are near impossible for even well-trained human eyes to follow. By filming these pursuits with high-speed cameras, Gonzalez-Bellido showed that they typically take a quarter of a second. They might even be over in half that time. A killer fly can capture its target in the space of a human blink.

Their ultrafast hunts are guided by ultrafast vision. It may seem strange to talk about animals seeing at different speeds, because light is the fastest thing in the universe, and vision seems instantaneous to us. But eyes don't work at light speed. It takes time for photoreceptors to react to incoming photons, and for the electrical signals they

generate to travel to the brain. In killer flies, evolution has pushed these steps to their limits. When Gonzalez-Bellido shows these insects an image, it takes just 6 to 9 milliseconds for their photoreceptors to send electrical signals, for those signals to reach their brains, *and* for their brains to send commands to their muscles.[*22] By contrast, it takes between 30 and 60 milliseconds for human photoreceptors to accomplish just the first of those steps. If you looked at an image at the same moment as a killer fly, the insect would be airborne well before a signal had even left your retina. “We don’t know of a faster photoreceptor than the ones from these flies,” Gonzalez-Bellido tells me. She says it with something approaching pride.[*23]

The fly’s vision also updates more quickly. Imagine looking at a light that flickers on and off. As the flickering gets faster, there will come a point when the flashes merge into a steady glow. This is called the critical flicker-fusion frequency, or CFF. It’s a measure of how quickly a brain can process visual information. Think of it as the frame rate of the movie playing inside an animal’s head—the point at which static images blend into the illusion of continuous motion. For humans, in good light, the CFF is around 60 frames per second (or hertz, Hz). For most flies, it’s up to 350. For killer flies, it’s probably higher still. To its eyes, a human movie would look like a slideshow. The fastest of our actions would seem languid. An open palm, moving with lethal intent, would be easily dodged. Boxing would look like tai chi.

In general, animals tend to have higher CFFs if they’re smaller and faster. Compared to human vision, cats are slightly slower (48 Hz) and dogs slightly faster (75 Hz). The eyes of a scallop are positively glacial (1 to 5 Hz), and those of nocturnal toads are slower still (0.25 to 0.5 Hz). Those of

leatherback turtles (15 Hz) and harp seals (23 Hz) are faster but still sluggish. Those of swordfish aren't much better under normal conditions (5 Hz), but these fish can heat up their eyes and brains with a special muscle, boosting the speed of their vision by eight times. Many birds have naturally fast vision; with a maximum CFF of 146 Hz, the pied flycatcher—a small songbird—has the fastest vision of any vertebrate that's been tested, perhaps because its survival depends on tracking and catching flying insects.[*24] And those insects have eyes that are faster still. Honeybees, dragonflies, and flies have CFFs between 200 and 350 Hz.

It's possible that each of these visual speeds comes with a different sense of time's passage. Through a leatherback turtle's eyes, the world might seem to move in time-lapse, with humans bustling about at a fly's frenetic pace. Through a fly's eyes, the world might seem to move in slow motion. The imperceptibly fast movements of other flies would slow to a perceptible crawl, while slow animals might not seem like they were moving at all. "Everyone asks us how we catch the killer flies," Gonzalez-Bellido says. "You just move toward them slowly with a vial. If you're slow enough, you're just part of the background."

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FAST VISION REQUIRES a lot of light, so killer flies can only be active during the day. Other animals are not so limited.

After the sun's golden fingers withdraw from the Panamanian rainforest and the understory's shade thickens into an even deeper darkness, a small bee emerges from a hollow stick. This is *Megalopta genalis,* a sweat bee. Its legs and abdomen are golden yellow. Its head and torso are

metallic green. None of those beautiful hues are usually visible to human observers because the bee only emerges when there's too little light for humans to see, let alone see in color. But despite the darkness, *Megalopta* slaloms through a labyrinth of lianas and tracks down its favorite flowers. Having collected its fill of pollen, it somehow then returns to the very same thumb-width stick in which it nests.

Eric Warrant, who grew up collecting insects and now studies their eyes, first encountered *Megalopta* in 1999 on a research trip to Panama. He quickly confirmed, to his astonishment, that it uses vision to guide its nighttime flights. By filming the insect with infrared cameras, Warrant saw that when it first emerges from its stick, it turns around and hovers slowly in front of the entrance, memorizing the appearance of the surrounding foliage. Later, when it has finished foraging, it uses this visual memory to find its way home. If Warrant set up his own landmarks, like white squares, and moved them to another stick while the bee was away, it would return to the wrong place. The bee's feat would be hard enough in bright daylight: Rainforests are neither easy to navigate nor short of sticks. But *Megalopta* somehow finds its home "in the dimmest imaginable light," Warrant says. He has filmed the bee finding its nest on nights so dark that he couldn't even see his own hand in front of his face. He had to use night-vision goggles to see what the bee could with its own eyes. "They're no clumsier in the dark than a honeybee is in bright sunlight," Warrant tells me. "They come flying in quite rapidly, they don't hesitate, and they land incredibly quickly. It's one of the most amazing things I've ever seen."

Warrant suspects that *Megalopta*'s ancestors veered toward a nocturnal schedule to escape intense competition

from daylight pollinators, including other bees. But life at night isn't easy for animals that rely on vision, for two major reasons. The first is obvious: There's much less light. Even the light of a full moon is a million times dimmer than full daylight. A moonless night that's illuminated by stars alone is a hundred times dimmer still. A night where starlight is obscured by clouds or tree cover is a hundred times dimmer again. These are the kinds of conditions in which *Megalopta* can still navigate—starless darkness that offers barely enough light for an eye to collect. The second challenge is less intuitive: Photoreceptors can accidentally go off on their own, and at night, these false alarms can easily outnumber the real signals from actual photons. So nocturnal animals must not only detect the little light that's there but also ignore the phantom lights that aren't. They must overcome both the limits of physics and the messiness of biology.

Some animals have simply dropped out of the struggle. Like all sensory systems, eyes are expensive to build and maintain. It takes a lot of energy to even prep photoreceptors and their associated neurons for the arrival of light, so that they can react when needed. Even when animals aren't seeing anything, the mere possibility of sight drains their resources. This drain is significant enough that if eyes stop being useful or effective, they tend to diminish or disappear. Sometimes animals invest in other senses that aren't yoked to light. (We'll meet these later; many exceptional senses were discovered because scientists noticed animals doing amazing things in total darkness.) Others unsubscribe from vision entirely. In underground realms, in caves, and in other dark corners of Earth where vision cannot earn its worth, eyes are often lost.[*25]

Other animals, instead of ceding their vision to the dark, have evolved ways of seeing in the dimmest of conditions. Some use neural tricks, including the sweat bee that Warrant studied. It pools the responses from several different photoreceptors, turning lots of smaller pixels into a few large megapixels. Its photoreceptors might also collect photons for more time before firing, like a camera whose shutter is left open for a longer exposure. These two strategies group the photons reaching the bee's eye in both space and time, increasing the ratio of signal to noise. Its vision is grainy and slow as a result but remains bright when brightness seems impossible. And "seeing a coarser, slower, brighter world is better than seeing nothing at all," Warrant says.[*26]

Animals can also see in the dark by grabbing every last photon they can. Some species, including cats, deer, and many other mammals, have a reflective layer called a tapetum, which sits behind their retinas and sends back any light that gets past their photoreceptors; those cells then get a second chance to collect the photons they initially missed.[*27] Other animals have evolved exceptionally large eyes and wide pupils. The tawny owl's eyes are so big that they bulge out of its head. The tarsiers—small primates from Southeast Asia that look like gremlins—have eyes that are each larger than their brains. And the biggest eyes of all evolved in one of the darkest environments in the planet—the deep ocean.

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TO DIVE INTO the ocean is to enter the largest habitat on the planet—a realm with over 160 times more living space than

all the ecosystems on the surface combined. Most of that space is dark.

At 10 meters down, 70 percent of the light from the surface has been absorbed. If you were descending in a submersible, anything red, orange, or yellow on your person would now look black, brown, or gray. By 50 meters, greens and violets have largely vanished, too. By 100 meters, there is only blue, at just 1 percent of its surface intensity, if that. By 200 meters, the start of the mesopelagic or twilight zone, that intensity has fallen by another 50 times. The blue is now almost laser-like—eerily pure and all-encompassing. Through it, silvery fish dart about. Gelatinous jellyfish and siphonophores slowly snake past. At 300 meters, it's as dark as a moonlit night, and getting darker. Gradually, the fish get blacker, the invertebrates redder. Increasingly, they produce their own light, and their bioluminescent flashes paint the outline of your descending submersible. At 850 meters, the residual sunlight is so faint that your eyes can no longer function. At 1,000 meters, no animal eyes can. This is the beginning of the bathypelagic or midnight zone. The complex visual scenes of the surface are long gone and have been replaced by a living star-field of bioluminescence, twinkling in the otherwise total darkness. Depending on where you are in the world, there might be another 10,000 meters of ocean left to go.

The deep ocean's consummate darkness creates a problem for the scientists who want to study its denizens. Researchers can't see what's around them unless they turn on their submersible's lights, but doing so is devastating for creatures that have adapted to a lightless life. Even moonlight can blind a deep-sea shrimp in a few seconds. A submersible's headlights will do much worse. Some deep-

sea animals end up doing kamikaze runs at subs. Startled swordfish ram them with their swords. Other creatures freeze or flee. “The way to think about ocean exploration is that we probably create a sphere a hundred yards wide that keeps away anything that can get away,” says Sonke Johnsen. “Most of the time, we’re seeing terror and blindness. We see how animals behave when they think they’re being killed by some glowing god.”

To be more respectful of deep-sea Umwelten, Johnsen’s mentor Edith Widder created a stealth camera called Medusa. It films deep-sea animals with red light that most of them can’t see, and attracts them with a ring of blue LEDs that resemble a bioluminescent jellyfish. “The only real innovation is that we turned off the lights,” he says. “Once we do that, really big stuff shows up.”

In June 2019, Widder and Johnsen took Medusa on a 15-day research cruise through the Gulf of Mexico. Under what seemed to be the only storm in the Gulf, they would manually lower the 300-pound camera to the end of its 2,000-meter line, and then haul it up again the next night. “Have you ever pulled up a fridge-sized object for a mile?” Johnsen asks me. “It took three hours every night.” After every deployment, Nathan Robinson would pore over Medusa’s videos. And over the course of the first four, “we saw a shrimp making a little bioluminescence,” Johnsen says. “Yay?”

Then, on June 19, “I’m on the bridge, and all of a sudden, Edie’s at the bottom of the stairs with a smile on her face that’s practically cracking her ears off, and I thought: This can only be one thing.” On its fifth outing, Medusa had filmed a giant squid.

The footage was unmistakable. At a depth of 759 meters, a long cylinder appears and snakes toward the camera

before unfurling into a mass of writhing, suckered arms. It briefly grabs the camera with two long tentacles before losing interest and withdrawing back into the dark. The crew estimated that it was a 10-foot-long juvenile, which was nowhere close to the species' maximum size of 43 feet. Still, it was a *giant squid*—an almost mythic animal, and one with the largest and most sensitive eyes on the planet.

As I noted at the start of this chapter, the eyes of a giant squid (and the equally long but much heavier colossal squid) can grow as big as soccer balls, with diameters up to 10.6 inches. These proportions are perplexing. Yes, bigger eyes are more sensitive, and it makes sense for an animal in the dark ocean to have them. But no other creature, including those that live in the deep sea, has eyes that are even in the same ballpark as a giant or colossal squid's. The next-largest eyes, which belong to the blue whale, are less than half the size. A swordfish's eye, which is the largest of any fish at 3.5 inches, could fit inside a giant squid's pupil. The squid's eyes are not just big; they are absurdly and excessively bigger than those of any other animal. What does it need to see that it can't see with a swordfish-sized eye?

Sonke Johnsen, Eric Warrant, and Dan-Eric Nilsson think they know the answer. They calculated that in the deep ocean, eyes suffer from diminishing returns. As they get bigger, they cost more energy to run but offer little extra visual power. Once they get past 3.5 inches—that is, swordfish-sized—there's little point in enlarging them further. But the team found that extra-large eyes *are* better at one task, and one task alone: spotting large, glowing objects in water deeper than 500 meters. There's an animal that fits those criteria, and it is one that giant squid really need to see: the sperm whale.

The largest toothed predators in the world, sperm whales are the giant squid's main nemeses. Their stomachs have been found full of the squid's parrot-like beaks, and their heads often bear circular scars inflicted by the serrated rims of the squid's suckers. They do not produce their own light, but just like a descending submersible, they trigger flashes of bioluminescence when they bump against small jellyfish, crustaceans, and other plankton. With its disproportionately large eyes, the giant squid can see these telltale shimmers from 130 yards away, giving it enough time to flee. It is the only creature with eyes large enough to see these bioluminescent clouds at a distance, and also the only one that *needs* to do so. "No other animals are looking for things that are really large at depth," Johnsen says. Sperm whales and other toothed whales use sonar rather than vision to find their food. Large sharks tend to go after smaller prey. Blue whales subsist on tiny shrimp-like krill. Krill might benefit from seeing the bioluminescent cloud of a blue whale, but their compound eyes are too limited in resolution, and their bodies are too slow to do anything with that information. Giant (and colossal) squid are unique in being massive animals that need to see massive predators, and their singular need has led to a singular Umwelt. With the largest and most sensitive eyes that exist, they scan one of the darkest environments on Earth for the faint sparkling outlines of charging whales.[*28]

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TURN OFF THE lights, and our world becomes monochromatic. This shift occurs because our eyes contain two types of photoreceptors— cones and rods. The cones

allow us to see colors, but they only work in bright light. In the dark, the more sensitive rods take over, and a kaleidoscope of daytime hues is replaced by the blacks and grays of the night. Scientists used to think that all animals were similarly color-blind at night.

Then, in 2002, Eric Warrant and his colleague Almut Kelber did a pivotal experiment with the elephant hawkmoth. This beautiful European insect has a pink-and-olive body and a wingspan of almost 3 inches. It feeds entirely at night, hovering in front of flowers and drinking their nectar with a long, unfurled proboscis. Kelber trained hawkmoths to drink instead from feeders, which sat behind blue or yellow cards. Having learned to associate these colors with food, the moths could reliably distinguish them from equally bright shades of gray. And they kept on doing so as Kelber turned down the lights in her lab.

At light levels equivalent to a half-moon, Kelber's world turned black-and-white, but the moths were still going strong. At one point, "it took me 20 minutes sitting in my dark lab to be able to see the moth," she tells me. "I couldn't even see its proboscis," but it was still drinking from the right feeders. The lights then faded to the levels of dim starlight, and, though Kelber couldn't see at all, the elephant hawkmoth could still perceive the cards in all their glorious color. But those colors were probably very different from the ones we perceive.

SKIP NOTES

*1 I ask Jakob how much of a jumping spider's above-average intelligence (for a spider) is baked into its senses. Spiders that mostly sense vibrations along their webs don't have a huge amount of information to interpret, she says. "For the really visual spiders, the complexity of information they have to deal with is so much higher," she says. "I can't help but think it's valuable for them

to be able to interpret it, and that seems like a good opening for evolution to push them toward higher and higher cognitive skills. But I don't know. We have to factor in our own human bias toward being visual."

*2 Each central eye actually has two lenses, one at the top and one at the bottom. The top lens collects and focuses light, while the bottom one spreads it out. This arrangement enlarges images before they hit the spider's retina, which is why these tiny animals can see as sharply as small dogs. The telescopes that Galileo started using in 1609 work in the same way, using tubes with lenses at both ends to peer at distant objects. Unbeknownst to him, he was unwittingly plagiarizing a structure that jumping spiders had evolved millions of years prior, and which, on clear nights, they can use to see the moon.

*3 Baby jumping spiders are transparent. With good lighting, you can see their eye tubes moving about inside their heads.

*4 What about the other two pairs of eyes? One seems to detect motion behind the spider. The other is very reduced, and its purpose is unclear.

*5 In 2012, evolutionary biologist Megan Porter compared almost 900 opsins from different species, and confirmed that they share a single ancestor. That original opsin arose in one of the earliest animals and was so efficient at capturing light that evolution never conjured up a better alternative. Instead, the ancestral protein diversified into a wide family tree of opsins, which now underlie all vision. Porter draws that tree as a circle, with branches radiating outward from a single point. It looks like a giant eye.

*6 There's always at least one person who writes in with a pompous and incorrect corrective, so let's get this out of the way: The word *octopus* is derived from Greek and not Latin, so the correct plural is not *octopi*. Technically, the formal plural would be *octopodes* (pronounced ock-toe-poe-dees) but *octopuses* will do.

*7 This distinction isn't universally agreed upon, and some researchers would argue that a stage-two eye—a photoreceptor plus a shading pigment—also counts as an eye.

*8 In 1994, Nilsson and Susanne Pelger simulated the evolution of a sharp stage-four eye from a simple stage-three one. The simulation began with a small, flat patch of photoreceptors. With every generation, the patch slowly thickens and curves into a cup. It gains a crude lens, which gradually

improves. Assuming pessimistically that the eye improves by just 0.005 percent every generation, and that each generation lasts for a year, it would take just 364,000 years for the blurry stage-three eye to become something like ours. As far as evolution goes, that's a blink of an eye.

*9 It's not the case, either, that advanced eyes always exist in advanced creatures and simple eyes always in simple ones. There are some microbes that consist entirely of single cells and which also double as surprisingly complex eyes. Consider the freshwater bacterium *Synechocystis*. Light that hits one side of its spherical cell becomes focused on the opposite side. The bacterium can sense where that light is coming from, and move in that direction. It is effectively a living lens, and its entire boundary is a retina. The warnowiids, a group of single-celled algae, also seem to be living eyes, and each cell has components that resemble a lens, an iris, a cornea, and a retina. What they see, and whether they see at all, are open questions.

*10 So why are zebras striped? Caro has a definitive answer: to ward off bloodsucking flies. African horseflies and tsetse flies carry a number of diseases that are fatal to horses, and zebras are especially vulnerable because their coats are short. But stripes, for some reason, confuse the biting pests. By filming actual zebras, as well as normal horses dressed in zebra-striped coats, Caro showed that flies would approach the animals and then fumble their landings. It's not yet clear why this happens.

*11 One oft-quoted study from the 1970s suggested that the American kestrel has an acuity of 160 cpd, but other studies of the same bird have found much lower values on a par with humans.

*12 There are two major groups of animal photoreceptors, known as ciliary and rhabdomeric. Both use opsins, but they function in very different ways. Scientists used to think that ciliary receptors were only found in vertebrates, and rhabdomeric ones were only in invertebrates. But that's not true: Both kinds of receptors are found in both groups. And both are found in the scallop, which has one retina full of ciliary photoreceptors and one full of rhabdomeric ones. Why? It's unclear, although one retina appears to be used to detect moving objects and the other is used for selecting habitats.

*13 It's not that scallop eyes are perfect. When light enters the eye, it must first get through the retina before the mirror can reflect and focus it. The retina gets two shots at absorbing that light—once on its unfocused initial pass, and again in its more focused form. This means that the eye sees a focused image against a background of blurry haze.

*14 This idea is especially compelling because the eyes are actually modified chemosensory tentacles. It's a visual system jury-rigged from one originally used for smell and touch.

*15 In 1964, Mike Land, who was still a graduate student, looked into a scallop's eye and saw an upside-down image of himself. That's how he discovered that each eye contains a focusing mirror. He later showed that the mirror consists of layered crystals, and suggested (correctly) that the crystals are made of guanine—one of the building blocks of DNA. Guanine crystals don't naturally form squares, so the scallop must somehow control their growth. It's unclear how it manages this, or how it gets every crystal to the same exacting measurement—74 billionths of a meter thick.

*16 Scallops aren't the only animals with perplexing distributed vision. Chitons are mollusks that look like the disembodied forehead of a Klingon from *Star Trek*; their bodies are covered in armored plates, and those plates are dotted with hundreds of small eyes. Fan worms look like colorful feather dusters, extending from rocky tubes; those plumes are tentacles, which teem with eyes. Giant clams look like…well, very big clams; their meter-wide mantles contain several hundred eyes. Dan-Eric Nilsson likens all of these eyes to burglar alarms. They detect nearby movement and encroaching shadows, so their owners know when to take defensive measures. The chitons clamp down onto rocks, the fan worms pull their fans back into their tubes, and the giant clams close their shells. It's likely that, like the scallops, none of these animals sees scenes.

*17 Like brittle stars, sea urchins also seem to use their entire bodies as a crude eyeball. Each urchin is a spiky ball that crawls around on hundreds of tube feet. Its photoreceptors are on those feet, and they are shaded either by the animal's spines or by its hard exoskeleton. Its vision may not be especially sharp, but it can certainly amble toward dark shapes.

*18 Why don't vultures just have wider visual fields that allow them to look ahead while flying? Martin thinks it's because their large, sharp eyes are vulnerable to dazzling glare from the sun. In general, he says, birds with large eyes tend to have larger blind spots. Birds with panoramic vision, like ducks, tend to have smaller and less acute eyes that can better tolerate the presence of the sun.

*19 Chickens and many other birds rely on frontal vision only at close range, when they want to accurately grab something with their beaks or feet.

*20 Turning the eyes is out of the question because birds of prey can barely move their eyes without turning their heads. Indeed, their eyes are so big that they almost touch each other inside the skull.

*21 A whale's pupil doesn't constrict by shrinking into a pinhole, like ours does. Instead, it pinches in the middle, creating what looks like an awkwardly smiling mouth with two small openings at either end. Each of these openings is effectively its own mini-pupil, and admits light onto a separate acute zone.

*22 The photoreceptors in a killer fly's eye fire quickly and reset quickly. Both traits demand a lot of energy. Compared to the photoreceptors of a fruit fly, those of a killer fly have three times more mitochondria—the bean-shaped batteries that supply animal cells with power.

*23 Other predatory insects, like dragonflies and robber flies, have large, high-resolution eyes with distinctive acute zones. As they pursue their targets, they turn their heads to keep the prey within the sharpest part of their visual field. Killer flies "have to pay attention in all directions," Gonzalez-Bellido says, so they don't have an acute zone, and their visual resolution isn't especially high. Despite that, they seem to have a more demanding hunting strategy. Dragonflies hunt against the sky, spotting the silhouettes of prey that fly above them. But killer flies somehow "do the impossible thing of hunting against the ground," Gonzalez-Bellido says. They'll pick out prey moving in front of complex backgrounds, and then chase those targets through leaves and other cluttered environments.

*24 Traditional fluorescent lights flicker at 100 Hz—that is, 100 times a second. That's too fast for humans to see, but not for many birds like starlings, for whom the lights must be stressful and irritating.

*25 There are many ways to break an eye, and evolution has explored them all. Lenses have degenerated. Visual pigments have disappeared. Eyeballs have sunk beneath the skin or been covered by it. One species alone, the Mexican cavefish, has lost its eyes several times over, as different sighted populations moved from bright rivers to dark caves and independently abandoned vision. As Eric Warrant tells me, "Why Gollum in *The Hobbit* had extra-big eyes makes no scientific sense."

*26 This doesn't fully account for *Megalopta genalis*'s night vision, though. "I can't explain how they do it," Warrant tells me. "I've got clues about some of the mechanisms they use to enhance vision in dim light, but I can't see the whole picture."

*27 Reflections from the tapetum are responsible for the eyeshine of dogs, cats, deer, and other animals illuminated by car headlights or camera flashes. The structure of a reindeer's tapetum changes in the dark winter to reflect even more light. Coincidentally, this also changes the tapetum's color, and thus the color of reindeer eyes, from golden yellow in the summer to a rich blue in the winter.

*28 The giant squid seems to be a global species that lives in every ocean. But for the longest time, it was known only from carcasses that washed ashore. The first photographs of this creature in the wild were only taken in 2004. The first natural footage was captured in 2012, when Widder and her colleagues deployed the then-new Medusa camera off the coast of Japan. Seven years later, the stealth camera proved its worth yet again, just 100 miles southeast of New Orleans. "That part of the Gulf is packed with oil rigs, and there are thousands of remotely operated vehicles there," Johnsen says. "Those pilots have never seen a giant squid, and we saw one on our fifth deployment. Either we are the luckiest people in the world, or it's that we turned our lights off." (They are pretty lucky. Half an hour after the crew saw the squid footage, lightning struck their ship, frying a lot of instruments but mercifully sparing Medusa's hard drive. Shortly after, the ship also dodged a waterspout.)

3.

Rurple, Grurple, Yurple

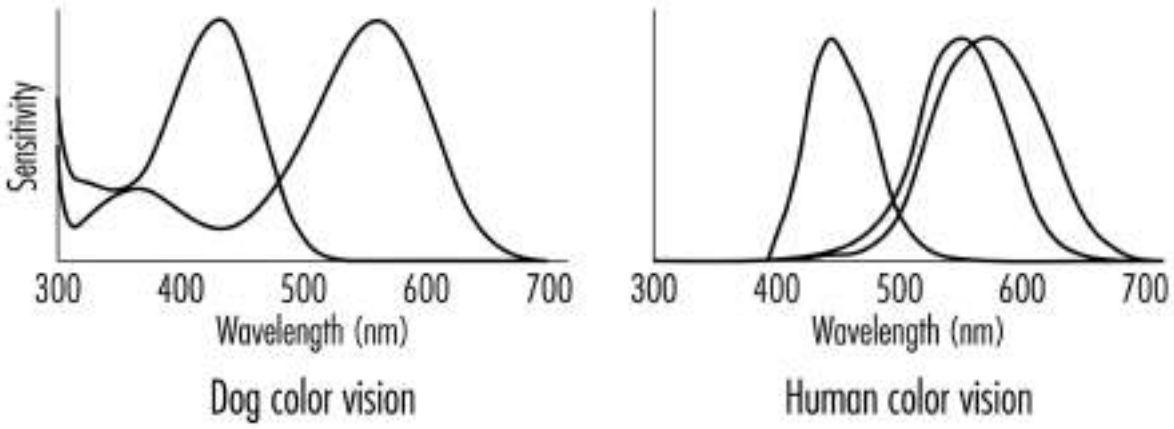
Color

WHEN MAUREEN AND JAY NEITZ adopted a toy poodle puppy, "like all good parents, we went out and read a book about how to raise a dog," Jay tells me. The book claimed that dog names should ideally have two syllables and hard consonants. The Neitzes brainstormed a few options, and Maureen, in joking reference to Jay's research on vision, suggested Retina. (I point out that Retina has three syllables. "Yes, but our version has two," Jay says. "Ret-na.") Black, fluffy, and very cute, Retina became a part of history. She was one of the dogs who first confirmed what colors dogs actually see.

In the 1980s, when the Neitzes were getting their PhDs, many people believed that dogs were color-blind. In *The Far Side,* cartoonist Gary Larson drew a dog praying at its bedside for "Mom, Dad, Rex, Ginger, Tucker, me, and all the rest of the family to see color." Scientists bought into this myth, too: One textbook claimed that "on the whole, mammals appear not to have color vision except for the primates." And yet, very few species had actually been carefully tested—including dogs, despite their popularity. "People would always ask me what their dogs see, and we had really no idea," Jay says. "Or we had ideas, but no evidence."

To get that evidence, he took Retina and two Italian greyhounds to his lab. He trained them to sit in front of three lit panels, one of which was differently colored. If

they touched the odd panel with their noses, they earned a cheesy treat. And they did, repeatedly. Dogs do see color. They just don’t see the same range that most people see. Nor do most other animals. To appreciate their varied visual palettes, we must first understand what color really is, how animals see it, and *why* they evolved to see it at all. Color vision is complicated enough that even a simplified explanation, which I’m about to lay out, can feel abstract and confusing. But bear with me: The details are the key to truly understanding birds, butterflies, and blossoms. We need to spend some time in the weeds to appreciate the flowers.



Each curve represents one class of cone cell; the peak of each curve shows the wavelength of light to which the cone is most sensitive. Note that dogs have two cone classes, while humans have three.

Light comes in a range of wavelengths. Those we can see span from 400 nanometers, which we perceive as violet, to 700 nanometers, which we perceive as red. Our ability to detect these wavelengths, and the rainbow that lies between them, depends on our opsin proteins—the foundation of all animal vision. Opsins come in different varieties, and each is best at absorbing a particular

wavelength of light. Normal human color vision depends on three of these opsins, each of which is deployed by a different type of cone cell in our retinas. Based on their preferred wavelengths, the opsins (and the cones that contain them) are called long, medium, and short. More familiarly, they're called red, green, and blue.[*1] When light bounces off a ruby and enters our eyes, it stimulates the long (red) cones strongly, the medium (green) ones moderately, and the short (blue) ones weakly. If that light bounces off a sapphire, the opposite happens—the short (blue) cones react most strongly, and the others less so.

But color vision involves more than merely *detecting* different wavelengths of light. It's about *comparing* them. The signals from the three types of cones are added and subtracted by a complex network of neurons. Some of these neurons are excited by inputs from the red cones but inhibited by inputs from the green ones; they allow us to discriminate reds from greens. Other neurons are excited by the blue cones but inhibited by the red *and* green ones; they allow us to distinguish blues and yellows. This simple neural arithmetic—R – G and B – (R + G)—is called opponency. It's how the raw signals from just three cones are transformed into the glorious rainbows that we perceive.

Opponency is the basis of (almost) all color vision. Without it, an animal doesn't really see colors in the way we imagine. *Daphnia* water fleas, for example, have four opsins that are sensitive to orange, green, violet, and ultraviolet wavelengths. But those wavelengths just trigger hardwired and almost reflexive responses. Ultraviolet means sun, so swim away. Green and yellow mean food, so swim toward. Water fleas can respond to four specific kinds of light that *we* see as colored. But being unable to

compare the signals from their four opsins, they can't perceive a spectrum.

Color, then, is fundamentally subjective. There's nothing inherently "green" about a blade of grass, or the 550-nanometer light that it reflects. Our photoreceptors, neurons, and brains are what turn that physical property into the sensation of green. Color exists in the eye of the beholder—and also in their brain. Consider the story of the artist Jonathan I., as told by Oliver Sacks and Robert Wasserman in "The Case of the Colorblind Painter." After a life of seeing and painting in colors, he suffered a brain injury that turned his world monochrome. His retinas were healthy, his opsins were present, and his cones were working. But his brain could only conjure up a world of blacks, whites, and grays. Even when he closed his eyes, his imagined world was drained of color.

A small proportion of people, and entire species of animals, also see only in shades of gray, not because of brain damage but because their retinas aren't set up for color vision. They are called monochromats. Some, like sloths and armadillos, only have rod cells, which work well in dim light but aren't geared toward color. Others, like raccoons and sharks, only have one cone, and since color vision depends on opponency, having one cone is effectively like having none. Whales have just one cone, too: To paraphrase the vision scientist Leo Peichl, for a blue whale, the ocean is not blue. Cone cells are unique to vertebrates, but other animals have wavelength-specific photoreceptors that play a similar role. Surprisingly, the cephalopods—octopuses, squid, and cuttlefish—have just one class of these, which means they are also monochromats.[*2] They can rapidly change the colors of their skin yet are unable to see their own shifting hues.

The existence of so many monochromats hints at one of the most counterintuitive things about color vision: It isn't necessary. Almost all the things that animals use their eyes for—navigating, foraging, communicating—can be done with shades of gray. What, then, is the point of seeing colors at all?

Physiologist Vadim Maximov suggested that the answer might lie around 500 million years in the past, during the Cambrian era, when the ancestors of modern animal groups arose. Many of those ancestral creatures lived in shallow seas, with rays of sunlight flickering around them. These rippling rays are beautiful to our modern eyes but would have been enormously confusing to ancient monochromatic ones. If the brightness of a given spot of water can change by a hundred times from one second to the next, it becomes much harder to spot relevant objects against a background. Is that dark shape that just appeared the looming shadow of a predator, or merely the shadow of a sunbeam that briefly strayed behind a cloud? Monochromatic eyes that only deal in brightness and darkness would struggle to tell. But eyes that see in color would fare much better. That's because different wavelengths of light tend to keep the same relative proportions, even when the total amount of light brightens or dims. A strawberry that looks red in bright sunlight still looks red in the shade, and its green leaves are still obviously green even under the reddish tint of a sunset. Color—and specifically color vision with opponency—offers *constancy*. If an animal can compare the outputs of photoreceptors that are tuned to different wavelengths, it can stabilize its view of a world where light dances and flickers. Even two classes will do the job. That's the basis of

dichromacy, the simplest form of color vision. It's what Retina, other dogs, and most mammals have.

Dogs have two cones—one with a long, yellow-green opsin and another with a short, blue-violet one. They see mostly in shades of blue, yellow, and gray. When my corgi Typo looks at his red-and-violet toy, he probably sees the red as a dark, muddy yellow, and the violet as a deep blue. When he looks at the bright-green ring that he likes to chew, the green stimulates both his cones equally. Because of opponency, those signals cancel out, and Typo sees white.

Horses are dichromats, too, and their cones are sensitive to wavelengths very similar to those a dog's respond to. This means that horses struggle to make out the orange markers that are used to highlight obstacles at racecourses. These orange blazes stand out to trichromatic human vision, but Sarah Catherine Paul and Martin Stevens showed that they blend into the background to a horse's dichromatic eyes. If we designed racecourses for horse vision, we'd paint the markers fluorescent yellow, bright blue, or white.

Then again, if we designed racecourses for *inclusive* human vision, we'd probably do the same. Most "color-blind" people are also dichromats, because they're missing one of the three usual cones. They still see colors, albeit in a narrower range. There are many kinds of color-blindness, but deuteranopes, who lack the medium green cones, come closest to seeing like dogs and horses. Their world is painted in yellows, blues, and grays, while reds and greens are hard to distinguish. Color-blind people might be confused by traffic lights, electrical wiring, or paint swatches. They might struggle to read packaging or charts, to distinguish sports teams that are wearing ostensibly

distinct colors, or to complete seemingly simple school assignments like drawing a rainbow. In some countries, they might be disqualified from flying planes, joining the military, or even driving. Color-blindness shouldn't be a disability, but it can be because humans have built cultures that are predicated on trichromacy. And what's so special about trichromacy, other than that most people have it? If dichromacy is good enough for most mammals, why are we and other primates different? Why do we see the colors we do?

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THE FIRST PRIMATES were almost certainly dichromats. They had two cones, short and long. They saw in blues and yellows, like dogs. But sometime between 29 and 43 million years ago, an accident occurred that permanently changed the Umwelt of one specific lineage of primates: They gained an extra copy of the gene that builds their long opsin. Such duplications often happen when cells divide and DNA is copied. They're mistakes, but fortuitous ones, for they provide a redundant copy of a gene that evolution can tinker with without disrupting the work of the original. That's exactly what happened with the long-opsin gene. One of the two copies stayed roughly the same, absorbing light at 560 nanometers. The other gradually shifted to a shorter wavelength of 530 nanometers, becoming what we now call the medium (green) opsin. These two genes are 98 percent identical, but the 2 percent gulf between them is also the difference between seeing only in blues and yellows and adding reds and greens to the mix.[*3] With the new medium opsins joining the earlier long and short ones, these primates had evolved trichromacy. And they passed

their expanded vision to their descendants—the monkeys and apes of Africa, Asia, and Europe, a group that includes us.

This story explains *how* we came to see the colors we see, but not *why*. Why exactly did the duplicated long-opsin gene shift toward a medium wavelength? The answer might seem obvious: to see more colors. A monochromat can make out roughly a hundred grades of gray between black and white. A dichromat adds around a hundred steps from yellow to blue, which multiplies with the grays to create tens of thousands of perceivable colors. A trichromat adds another hundred or so steps from red to green, which multiplies again with a dichromat's set to boost the color count into the millions. Each extra opsin increases the visual palette exponentially. But if dichromats can flourish with just tens of thousands of colors, why do trichromats benefit from millions?

Since the nineteenth century, scientists have suggested that trichromats would do better at spotting red, orange, and yellow fruit against green foliage.[*4] More recently, some researchers have argued that their advantage lies more in finding the most nutritious rainforest leaves, which tend to flush red when they are young and rich in protein. These explanations aren't mutually exclusive: Most primates eat fruits, but at times when those aren't ripe or available, larger species can make do with young leaves. That's the "perfect setting for the evolution of trichromacy," says Amanda Melin, who studies primate vision (and occasionally, as we saw in the last chapter, zebra stripes). "It's useful for finding your main food and your fallback food."[*5]

The monkeys of the Americas complicate this story. They also evolved trichromacy, but in a distinct way with very

different consequences. In 1984, Gerald Jacobs noticed that some squirrel monkeys were sensitive to red light, but others were not. And with help from Jay Neitz, he worked out why. These monkeys never developed a second copy of the long-opsin gene.[*6] Instead, their original gene now comes in several versions, some of which still produce long cones and some of which make medium cones. The gene also sits on the X chromosome, which means that the male monkeys (which are XY) can only ever inherit one version. Medium or long, it doesn't matter: They're destined to dichromacy. The female monkeys, however, are XX. Some of them inherit *both* the medium and long versions, one on each of their X chromosomes. That gives them trichromacy.[*7] So when a group of these monkeys cavorts through the treetops in search of food, some will see red fruits against green leaves, while others will only see yellows and grays. Even brothers and sisters can perceive different colors.

It's easy to assume that the dichromats must be at a disadvantage. But after 15 years of studying white-faced capuchins in the forests of Costa Rica, Amanda Melin thinks differently. By following several groups of these monkeys, she learned to identify every individual on sight. And by collecting their poop and sequencing their DNA, she worked out which were trichromats and which were dichromats. Neither group, she found, is more likely to survive or reproduce than the other. The trichromats are indeed better at finding brightly colored fruit, but the dichromats surpass them at finding insects disguised as leaves and sticks. Without a riot of colors to confuse or distract them, they're better at detecting borders and shapes, and seeing through camouflage. Melin has watched them nabbing insects that she, a trichromat, didn't even know were there. Seeing extra colors has both drawbacks

and benefits. More isn't necessarily better, which is why some females are still dichromats and all males are.

Or, I should say, *almost* all males. In 2007, the Neitzes added the human long-opsin gene to the eyes of two adult male squirrel monkeys, giving them three cones instead of two, and turning them into trichomats. The two monkeys—Dalton and Sam—suddenly performed differently on the same vision tests that they had been doing every day for two years, and could distinguish new colors that were previously invisible to them. Dalton died from diabetes shortly after the experiment. But as of April 2019, when I last spoke to Jay, Sam was still alive and in his 12th year of trichromacy. I wondered what his life was now like. Does he behave any differently? Does he react to fruit in new ways? "I tried to talk to him," Jay said, laughing. "How cool *is it*? That's the interesting thing, right? But he's very nonchalant."

To me, Sam's silence speaks volumes. He reminds us that seeing more colors isn't advantageous in and of itself. Colors are not inherently magical. They become magical when *and if* animals derive meaning from them. Some are special to us because, having inherited the ability to see them from our trichromatic ancestors, we imbued them with social significance. Conversely, there are colors that don't matter to us at all. There are colors we cannot even see.

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IN THE 1880S, John Lubbock—banker, archeologist, polymath—split a beam of light with a prism and shone the resulting rainbow onto ants. The ants scurried away from the light. But Lubbock noticed that they also fled from a

region just beyond the rainbow's violet end, which looked dark to his eyes. This area wasn't dark to the ants, though. It was bathed in ultraviolet—literally "beyond violet" in Latin. Ultraviolet (or UV) light has wavelengths ranging from 10 to 400 nanometers.[*8] It is largely invisible to humans, but must be "apparent to the ants as a distinct and separate colour (of which we can form no idea)," Lubbock presciently wrote. "It would appear that the colours of objects and the general aspect of nature must present to them a very different appearance from what it does to us."

At the time, some scientists believed that animals either are color-blind or see the same spectrum that we do. Lubbock showed that ants are exceptional. Half a century later, bees and minnows turned out to see ultraviolet, too. The narrative shifted: *Some* animals can see colors we can't, but the skill must be very rare. But after another half century, in the 1980s, researchers showed that many birds, reptiles, fish, and insects have UV-sensitive photoreceptors. The narrative changed again: UV vision exists in many groups of animals, but not in mammals. Still wrong: In 1991, Gerald Jacobs and Jay Neitz showed that mice, rats, and gerbils have a short cone that is tuned to UV. Okay, *fine,* mammals *can* have UV vision, but only small ones like rodents and bats. Not so: In the 2010s, Glen Jeffery found that reindeer, dogs, cats, pigs, cows, ferrets, and many other mammals can detect UV with their short blue cones. They probably perceive UV as a deep shade of blue rather than a separate color, but they can sense it nonetheless. So can some humans.

Our lenses typically block out UV, but people who have lost their lenses to surgeries or accidents can perceive UV as whitish blue. This happened to the painter Claude Monet, who lost his left lens at the age of 82. He began

seeing the UV light that reflects off water lilies, and started painting them as whitish blue instead of white. Monet aside, most people can't see UV, which probably explains why scientists were so eager to believe that the ability was rare. In fact, the opposite is true. Most animals that can see color can see UV. It's the norm, and we are the weirdos.[*9]

Ultraviolet vision is so ubiquitous that much of nature must look different to most other animals.[*10] Water scatters UV light, creating an ambient ultraviolet fog, against which fish can more easily see tiny UV-absorbing plankton. Rodents can easily see the dark silhouettes of birds against the UV-rich sky. Reindeer can quickly make out mosses and lichens, which reflect little UV, on a hillside blanketed by UV-reflective snow. I could go on.

I'm going to go on. Flowers use dramatic UV patterns to advertise their wares to pollinators. Sunflowers, marigolds, and black-eyed Susans all look uniformly colored to human eyes, but bees can see the UV patches at the bases of their petals, which form vivid bullseyes. Usually, these shapes are guides that indicate the position of nectar. Occasionally, they are traps. Crab spiders lurk on flowers to ambush pollinators. To us, these spiders seem to match the colors of their chosen blooms, and they've long been treated as masters of camouflage. But they reflect so much UV that they are highly conspicuous to a bee, which makes the flowers they sit upon that much more alluring. Rather than blending in, some of them attract their UV-sensitive prey by standing out.

Many birds also have UV patterns in their feathers. In 1998, two independent teams realized that much of the "blue" plumage of blue tits actually reflects a lot of UV; as one of them wrote, "Blue tits are ultraviolet tits." To humans, these birds all look much the same. But thanks to

their UV patterns, males and females look very different from each other. The same is true for more than 90 percent of songbirds whose sexes are indistinguishable to us, including barn swallows and mockingbirds.

It's not just humans who can't see UV patterns. Since UV light is heavily scattered by water, predatory fish that have to spot prey at a distance are often insensitive to it. Their prey, in turn, have exploited this weakness. The swordtail fish of Central American rivers look drab to us, but as Molly Cummings and Gil Rosenthal showed, males of some species have strong UV stripes along their flanks and tails. These markings are alluring to females, but they're invisible to the swordtails' main predators. And in places where those predators are more common, swordtails have more vivid UV markings. "They could get away with being super-flamboyant" without attracting danger, Cummings says. Similar secret codes exist in Australia's Great Barrier Reef, home to the ambon damselfish. To human eyes, it resembles a lemon with fins, and looks identical to other closely related species. But Ulrike Siebeck found that its head is actually streaked with UV stripes, as if invisible mascara had run all over its face. Predators can't see these markings, but the ambons themselves use them to distinguish their own kind from other damselfish.

For us, UV feels enigmatic and intoxicating. It's an invisible hue lying just on the edge of our vision—a perceptual void that our imaginations are keen to fill. Scientists have often attributed special or secret significance to it, treating it as a channel for covert communication. But aside from the ambon damselfish and swordtails, most such claims have foundered.[*11] The reality is that UV vision and UV signals are extremely

common. “My personal view is that it’s just another color,” Innes Cuthill, who studies color vision, tells me.

Imagine what a bee might say. They are trichromats, with opsins that are most sensitive to green, blue, and ultraviolet. If bees were scientists, they might marvel at the color we know as red, which they cannot see and which they might call “ultrayellow.” They might assert at first that other creatures can’t see ultrayellow, and then later wonder why so many do. They might ask if it is special. They might photograph roses through ultrayellow cameras and rhapsodize about how different they look. They might wonder whether the large bipedal animals that see this color exchange secret messages through their flushed cheeks. They might eventually realize that it is just another color, special mainly in its absence from their vision. And they might wonder what it would be like to add it to their Umwelt, bolstering their three dimensions of color with a fourth.

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NESTLED 9,500 FEET up in Colorado’s Elk Mountains, the town of Gothic was once home to a thriving silver mine. When the value of silver crashed in the late nineteenth century, Gothic became a ghost town. But in 1928, it was reborn as, of all things, a research station. Today, the Rocky Mountain Biological Laboratory, affectionately known as Rumble, attracts scientists from around the world. Hundreds of them migrate there every summer to live and work among what looks like the set of a Western, to study the local soils and streams, ticks and marmots. When Mary Caswell “Cassie” Stoddard arrived there in 2016, she had hummingbirds on her mind.

“I grew up watching birds, but it wasn’t until I got to college that I learned birds can perceive colors humans can’t,” Stoddard tells me. “I found that mind-blowing.” Most birds have four types of cone cells, with opsins that are most sensitive to red, green, blue, and either violet or UV. That makes them *tetrachromats*. Theoretically, they should be able to distinguish a multitude of colors that are imperceptible to us. To confirm that they can, Stoddard and her team tested Rumble’s resident broad-tailed hummingbirds—a beautiful species with iridescent green feathers and, in the males, bright magenta bibs.

Exploiting the hummingbirds’ natural instinct to feed from colorful flowers, Stoddard attracted them to feeders placed near special lights, which had been customized to produce colors that a tetrachromat should be able to see. One light might illuminate a nectar-containing feeder with a mix of green and ultraviolet, while another might shine pure green onto a water-containing feeder. Stoddard couldn’t tell the difference between these colors, but the hummingbirds could, with minimal experience. Over the course of a day, they would increasingly flock toward the nectar feeder, having “learned to distinguish between lights that look identical to us,” she says. “That’s what we always predicted, but seeing it with our own eyes was thrilling.”[*12]

Even with experiments like this, it is easy to underestimate what other birds can see. They don’t just have human vision plus ultraviolet, or bee vision plus red. Tetrachromacy doesn’t just widen the visible spectrum at its margins. It unlocks an entirely new *dimension* of colors. Remember that dichromats can make out roughly 1 percent of the colors that trichromats see—tens of thousands, compared to millions. If the same gulf exists between

trichromats and tetrachromats, then we might be able to see just 1 percent of the *hundreds of millions* of colors that a bird can discriminate. Picture trichromatic human vision as a triangle, with the three corners representing our red, green, and blue cones. Every color we can see is a mix of those three, and can be plotted as a point within that triangular space. By comparison, a bird's color vision is a *pyramid,* with four corners representing each of its four cones. Our entire color space is just *one face* of that pyramid, whose spacious interior represents colors inaccessible to most of us.

If our red and blue cones are stimulated together, we see purple—a color that doesn't exist in the rainbow and that can't be represented by a single wavelength of light. These kinds of cocktail colors are called non-spectral. Hummingbirds, with their four cones, can see a *lot* more of them, including UV-red, UV-green, UV-yellow (which is red + green + UV), and probably UV-purple (which is red + blue + UV). At my wife's suggestion, and to Stoddard's delight, I'm going to call these rurple, grurple, yurple, and ultrapurple.[*13] Stoddard found that these non-spectral colors and their various shades account for roughly a third of those found on plants and feathers. To a bird, meadows and forests pulse with grurples and yurples. To a broad-tailed hummingbird, the bright magenta feathers of the male's bib are actually ultrapurple.

Tetrachromats also have a different concept of white. White is what we perceive when all our cones are equally stimulated. But you'd need a different blend of wavelengths to excite a bird's quartet of cones than you would a human's trio. Paper is treated with dyes that happen to absorb UV, so it wouldn't look white to a bird. Many

supposedly “white” bird feathers reflect UV and wouldn’t necessarily look white to birds, either.

It’s hard to know what birds make of rurples, grurples, and other non-spectral colors, Stoddard says. As a violinist, she knows that two simultaneously played notes can either sound separate or merge into completely new tones. By analogy, do hummingbirds perceive rurple as a blend of red and UV, or as a sublime new color in its own right? When they make choices about which flowers to visit, “do they group rurple with reds, or do they see it as an entirely different hue?” she asks. They can tell that it’s different from pure red, “but I can’t articulate what it looks like to them.”

Birds aren’t the only tetrachromats. Reptiles, insects, and freshwater fish, including the humble goldfish, have four cones as well. By looking at tetrachromats among modern animals and working backward, scientists can deduce that the first vertebrates were likely tetrachromats, too. Mammals, probably because they were all initially nocturnal, lost two of their ancestral cones and became dichromats. But they scurried beneath the feet of dinosaurs, which were almost certainly tetrachromats and “probably saw all kinds of cool non-spectral colors,” Stoddard says. It’s ironic that for the longest time, illustrators and filmmakers portrayed dinosaurs in dull shades of brown, gray, and green. Only recently have artists started painting these animals with bright colors, inspired by the revelation that they are the ancestors of birds. But even these vivid hues, applied with a trichromat’s eye, capture just a tiny proportion of the colors that dinosaurs probably wore or saw.

It is much easier for most people to imagine a dog’s sense of color than a bird’s (or a dinosaur’s). If you are a

trichromat, you can simulate dichromatic vision by using apps that remove certain colors. You could even simulate what a different trichromat (like a bee) might see by mapping their blue, green, and UV system onto our red, green, and blue one. But there is no way of representing a tetrachromat's color vision for a trichromatic eye. "People often ask if we can engineer goggles to allow humans to see these non-spectral colors—and I wish!" Stoddard says. You could use a spectrophotometer to find the rurples and grurples on a bird's feathers, but you'd then have to recolor them with our more limited range of colors. Four into three just won't go. Frustrating though it might be, most of us simply cannot imagine what many animals actually look like to each other, or how varied their sense of color can be.

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EVEN FOR A butterfly, the red postman has a peculiarly delicate style of flight. With fast wingbeats but surprisingly little forward motion, it seems to be trying very hard to be nowhere in particular. Its languid movements befit its defenses: Full of toxins, and clad in red, black, and yellow warning colors, it's in no rush to avoid predators. But there is nothing off-putting about them to human eyes. In a greenhouse in Irvine, California, I watch as two dozen of these butterflies flutter by my head, between the red and orange flowers of lantana plants. Between their bright colors and soothing movements, the world feels both richer and more tranquil. The technical name for these butterflies is *Heliconius erato,* and both parts feel fitting. In Greek mythology, Mount Helicon was the home of the Muses and a source of poetic inspiration; Erato was the Muse of love poetry.

One erato butterfly lands on the shoot of a lantana plant, curls her abdomen, and deposits a tiny golden egg. Five more sit sociably together on a nearby leaf, slowly opening and closing their wings. Another alights on the display of the greenhouse's climate control system, which reads 97 degrees Fahrenheit and 59 percent humidity. Jeans, I realize, were a mistake. Next to me, Adriana Briscoe, who is more sensibly dressed, is looking around and beaming broadly. This greenhouse is hers, and it is both a workplace and a retreat, somewhere she goes to feel happy and calm. "I love being here," she says wistfully. "You can see why many scientists have devoted their careers to studying these butterflies."

Throughout Central and South America, erato typically lives alongside a close relative—*Heliconius melpomene,* named after the Muse of tragedy. Both erato and melpomene are toxic, and they mimic each other so that any predator that learns to avoid one will also avoid the other. In any one place, these two species look almost identical. But across their range, they vary considerably. In Tarapoto, Peru, both erato and melpomene have red bands on their forewings and yellow bands on their hindwings. But in Yurimaguas, just 80 miles away, both species have yellow splotches and red bases on their forewings, and red stripes on their hindwings. You'd scarcely believe that eratos from the two sites were actually the same species, and you'd struggle to distinguish between eratos and melpomenes at any one site. Briscoe's greenhouse could have been full of both, and I would never have known. So how do the butterflies themselves tell the difference? When Briscoe started studying them in the late 1990s, it struck her as odd that no one knew. "For such visual animals that

are also very popular, it seems like it would have been an obvious thing to do to look at their eyes," she says.

Most butterflies are trichromats. Like bees, they have three opsins that are most sensitive to UV, blue, and green, and can see colors ranging from red to UV. But in 2010, Briscoe discovered that *Heliconius* butterflies differ from their relatives in two important ways. First, they're tetrachromats. Alongside the usual blue and green opsins, they have *two* UV opsins that peak at different wavelengths. Second, while related butterflies pattern their wings with yellow pigments, *Heliconius* uses yurple—the non-spectral color that mixes UV and yellow. These two traits are related. With two UV opsins, the *Heliconius* species can carve up the UV part of the spectrum into finer gradations, and discriminate between subtly different shades of UV-based colors. And by painting their wings with those colors, they can better tell the difference between their own kind and their mimics. Even birds, with their single UV opsin, don't seem to discriminate between yellow and the shade of yurple the butterflies use.

The male erato butterflies can't, either. In 2016, Briscoe's student Kyle McCulloch found that only female eratos are tetrachromats. The males are trichromats. They have the gene for the second UV opsin, but for some reason they suppress it. Just like squirrel monkeys, the female eratos have an extra dimension to their color vision that males lack.[*14] In Briscoe's greenhouse, we watch as two eratos start to have sex. Their abdomens join, but before they can separate, the female takes off with the male still stuck to her. They flutter off as one, briefly conjoined by their genitals but forever separated by their Umwelten.

These butterflies are not the only species with a sex difference in tetrachromacy. *Humans* share that trait.

Somewhere in Newcastle, England, lives a woman known in the scientific literature as cDa29. She's a private person who doesn't do interviews, and her real name isn't publicly known. But according to psychologist Gabriele Jordan, who has worked with her extensively, cDa29 aces tests that only a tetrachromat could pass. Much like Stoddard's hummingbirds, she can pick out one shade of green among other extremely similar ones, "like a cherry from a tree," Jordan tells me. "For us, it's just green among greens. Other people look and look and look and then maybe have a guess. She can spot the odd one out within milliseconds."

Human tetrachromats are usually women, because the genes for the long and medium opsins both sit on the X chromosome. Since most women have two X chromosomes, they can inherit two slightly different versions of either gene. They would then end up with *four* different kinds of opsins that are tuned to different wavelengths—short, medium, long-a, and long-b, for example. Around one in eight women has this pattern…but most of them are not tetrachromatic. To possess that ability, a lot of other pieces need to fall in place. Normally, the red and green cones respond best to wavelengths that are just 30 nanometers apart. To produce a new and distinct dimension of color, the fourth cone has to sit almost exactly in the middle of that range, 12 nanometers away from the green. (That's what cDa29 has.) To build an opsin with that exact specification, "you almost have to split an atom genetically," Jordan says. Even if women can make the right kind of fourth cone, they need to have it in the right part of the retina—the central fovea, where our color vision is sharpest. And most important, they need the right neural wiring to perform opponency with the signals from these cones.

This combination of traits is rare enough that only a very small proportion of women with four cones are truly tetrachromatic. Jordan tells me that many people who say they are actually aren't. Artists, in particular, are often convinced that they can see more colors than others, but being more attentive to hues because of your work is not the same as seeing a whole other dimension of color. "I've tested many who turned out not to be tetrachromatic," Jordan says. "It's very attractive, the idea of superhuman vision.[*15] But it isn't as common as people make out." The first confirmed tetrachromat was cDa29; Jordan estimates that there are around 48,600 others in the United Kingdom, but they are not easy to find.[*16] They're not walking around with amazing technicolor clothes, just as dichromats aren't filling their lives with drab colors. Until cDa29 got tested, "she never thought there was anything special about her vision," Jordan says. "You're viewing the world with a given set of retinas and a given brain, and if you can't see with someone else's, it doesn't really cross your mind that you're better."

When Jordan first told me this, I confess to feeling a little disappointed, as I did when Jay Neitz told me that Sam the genetically engineered squirrel monkey was nonchalant about his newfound trichromacy. Colors matter to us. Color TVs, printers, and books are more prized than their black-and-white cousins. It's natural to expect that an extra dimension of color would be a spectacular thing to see. To learn that it could be taken for granted threatens to drain color of its magic. But of course, *all of us*—monochromat, dichromat, trichromat, or tetrachromat—take the colors that we see for granted. Each of us is stuck in our own Umwelt. As I wrote in the introduction, this is a book not about superiority but about diversity. The real

glory of colors isn’t that some individuals see more of them, but that there’s such a range of possible rainbows.

When thinking about human tetrachromats and erato butterflies, I’m struck by how absurd it is that people once thought all animals saw the same spectrum of colors as humans. Humans don’t even see the same colors as each other.[*17] We have varying forms of partial or complete color-blindness. Some of us are tetrachromats. Look across the rest of the animal kingdom and you’ll find even greater variations. Color vision varies considerably within the 6,000 species of jumping spiders, the 18,000 species of butterflies, and the 33,000 species of fish.

At least three kinds of color vision exist just within the eye of a larval zebrafish. The part of the fish’s retina that looks up at the sky sees in black and white, because color isn’t necessary for spotting the silhouettes of aerial predators. The part that looks straight ahead is dominated by UV detectors, which help it to spot tasty plankton. And the part that scans the horizon and the space below the fish is tetrachromatic. From black-and-white vision to more colors than humans can see, the eyes of these baby fish have it all.

To appreciate the colors that another animal sees, you can’t just add an Instagram filter over your own view. You can’t assume that those colors stay the same across a scene or a season, or from one individual to another. And you can’t just count the numbers of opsins or photoreceptors that an animal has and reconstruct its visual palette. Kentaro Arikawa has found that many butterflies have a frankly excessive number of photoreceptor classes. The cabbage white butterfly has eight, but one exists only in females and another only in males. The Japanese yellow swallowtail has six but uses only four, for tetrachromatic

vision; the other two are likely hardwired for specific tasks, like spotting objects of a specific color flying past. The champion among butterflies—the common bluebottle—has *15*. But these insects are not pentadecachromats, with 15-dimensional color vision. Only three of the photoreceptors are found all over the eye, while four are confined to the top half, and eight to the bottom. Arikawa expects that he'd find even finer segregations if he looked for them. The bluebottle butterfly, he thinks, is probably a tetrachromat that uses its other 11 classes of photoreceptors to detect very specific things in narrow parts of its visual field.

Indeed, color vision doesn't ever need to be more sophisticated than tetrachromacy. Based on the colors that reflect off natural objects, animals can see everything they could possibly need to with just four classes of photoreceptors, evenly spaced across the spectrum. Birds have close to the ideal setup. Anything more would be a wasteful and inefficient extravagance. So when scientists find animals with a lot more than four kinds of photoreceptors, there's probably something strange afoot.

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"IF YOU PUT your fingers in there, it's going to hit you," Amy Streets tells me, gesturing at a small aquarium tank in Brisbane, Australia. "If you want to try it…"

I do want to try it, but the animal in the tank has a reputation, and I'm nervous about testing it.

"How hard is the hit?" I ask.

"It's enough to surprise you," Streets says. "Do it."

I stick my pinky into the water. Almost instantly, there's a flash of green as a two-inch-long animal darts out and attacks me. There's a loud click, and a sharp but tolerable

pain in my finger. I feel strangely proud to have taken a punch from a purple spot mantis shrimp.

Mantis shrimps, also known as stomatopods (or, more affectionately, pods), are marine crustaceans. They're related to crabs and prawns but have evolved on their own for around 400 million years. The back half looks much like a small lobster. But the front half includes two folded arms that are slung underneath the animal's body like the mantises for which they are named. In the "spearer" species, these arms end in a row of fiendish spikes; in the "smashers," they end in a bludgeoning hammer. Both groups can unfurl these weapons at astonishing speeds, and need little excuse to do so. They punch their prey into submission. They punch anything that intrudes upon their burrows. They punch each other at first contact. Mantis shrimps throw punches like humans throw opinions—frequently, aggressively, and without provocation.

Their punches are the fastest and most powerful in the world. The clubs of a large smasher can accelerate like a high-caliber bullet and hit speeds of 50 miles per hour *in water*. These animals can punch their way into crab shells, out of aquaria, and through flesh and bone. For good reason, they've been nicknamed thumb-splitters, finger-poppers, and knuckle-busters. You can understand why I was nervous about letting one hit me. Even that individual, which was too small to do any damage, moved quickly enough to vaporize the water in front of its club. This created small bubbles, which made a popping sound as they collapsed—hence the click that I heard. "The different species sound slightly different in their smacking, which is kind of fun," Streets tells me.

She takes me to another tank that contains a peacock mantis shrimp, a gaudily colored smasher whose carapace

is streaked with reds, blues, and greens. Of the 500 stomatopod species, this is the most famous. It is also one of the most powerful. "*Don't* get hit by these guys," Streets says, emphatically. I take her advice. Instead of testing the peacock pod's patience, I stare at its eyes. There are two of them, which look like pink muffins wrapped in blue foil. They sit at the top of the animal's head, at the ends of mobile stalks. The left one is staring at me. The right one is looking at Streets. They are arguably the strangest eyes on the planet, and they see color in a way that no other animal shares. Of all the creatures we have encountered so far, the mantis shrimp's Umwelt is the hardest to imagine. After more than three decades, Justin Marshall, who runs the lab where Streets works, still struggles to do so.

Marshall's mother was a natural history illustrator, and his father was a marine biologist and curator of fish at London's Natural History Museum. They filled his childhood with beaches and boats, and his mind with a love of colors and marine life. In 1986, when his PhD advisor, Mike Land (whose work we met in the last chapter), asked him to choose between studying spiders, butterflies, or stomatopods, the decision was obvious. "I pretty rapidly chose mantis shrimps," Marshall tells me, "because they lived in the tropics."

He began his study by dissecting the eye of a peacock pod. Like other crustaceans, these animals have compound eyes, which consist of many separate light-gathering units. But, uniquely, each eye is split into three sections. There are two hemispheres with a distinct midband running between them, like the tropics wrapping around Earth. When Marshall looked at the midband under a microscope, he found a beautiful surprise—a kaleidoscopic array of colored blobs that were red, yellow, orange, purple, pink,

and blue. At the time, crustaceans were thought to be color-blind. This animal clearly wasn't. "I remember exactly what Mike said when I showed him the slide, which was, 'Fuck! Fuck, fuck, fuck! Fuck!' " Marshall says. "I thought, oh, this must be good."

Marshall guessed that the mantis shrimp uses these colored blobs to filter the light that reaches a single class of photoreceptors. In this way, it could see colors with an eye that would normally be color-blind. To test this idea, he traveled from England to the United States to work with Tom Cronin, who had both the right equipment and a burgeoning interest in stomatopods. Over a few intense weeks, the duo worked their way through the eye, analyzing any photoreceptors they could find. And to their shock, they found not one class, but at least *11*. "It didn't make sense," Cronin tells me. "We found a new one every time we looked at a new part of the eye. That was the most miraculous period of my whole career, Justin and I working together and discovering this." The mantis shrimp "could have a color vision system that outperforms anything previously described," the duo wrote in 1989. Or as Marshall puts it, "There were even more *fuck*s."

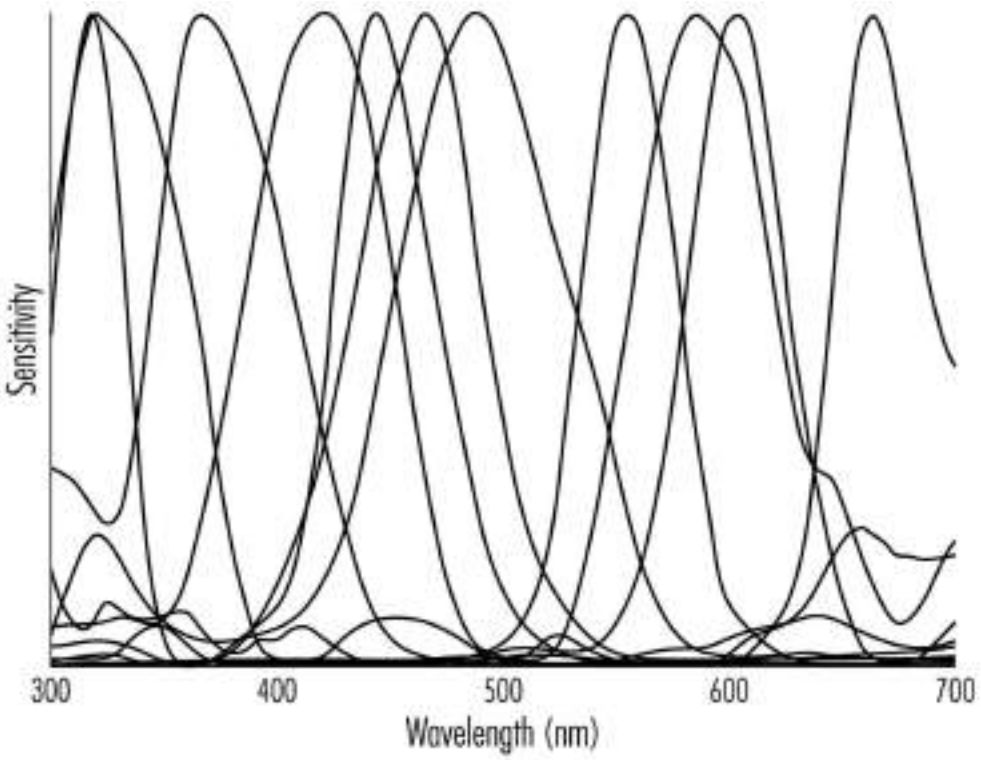
The midband consists of six rows of light-gathering units. Forget the bottom two for now; only the top four are used for color vision. Each row has three unique photoreceptors that are arranged in tiers. Row 1 has violet and blue receptors, row 2 has yellow and orange, row 3 has orange-red and red, row 4 has cyan and green, and each row has its own unique UV photoreceptor sitting on top of the others.[*18] That makes *12* photoreceptor classes, including four that are devoted to ultraviolet.[*19] Mantis shrimps have more classes of photoreceptors covering the ultraviolet spectrum than we have *in total*. What could they

possibly be doing with so many? Could they be dodecachromats, with 12-dimensional color vision? Or are they performing four kinds of trichromacy in each of the midband rows? Either way, they must surely be connoisseurs of color, able to tell even the subtlest differences between nigh-indistinguishable hues. A coral reef looks stunning enough to us; what must it look like to a stomatopod? Speculations have run amok. Imaginations have run wild. *The Oatmeal,* an online comic strip, suggested that "where we see a rainbow, a mantis shrimp sees a thermonuclear bomb of light and beauty."

It does not. In 2014, Marshall's student Hanne Thoen did a decisive experiment that upended the mantis shrimp's growing reputation. She trained them to attack one of two colored lights in exchange for a rewarding snack. She then altered the colors until they were similar enough that the animals could no longer tell them apart. Humans can distinguish colors whose wavelengths differ by between 1 and 4 nanometers. But the mantis shrimps failed with colors that were between 12 and 25 nanometers apart, which is roughly the gap between pure yellow and orange. For all their optical extravagance, they turned out to be abysmally bad at discriminating colors. Humans, bees, butterflies, and goldfish can all outperform them.

Marshall now thinks that the mantis shrimp sees colors in a unique way. Rather than discriminating between millions of subtle shades, its eye actually does the opposite, collapsing all the varied hues of the spectrum into just 12 colors, like a child's coloring book. Every kind of red stimulates the bottom photoreceptor of row 3. All shades of violet stimulate the top receptor of row 1. And rather than comparing the outputs of these 12 receptors through opponency, the retina just sends its raw signals directly to

the brain. The brain then uses these patterns to recognize specific colors, as if the visible spectrum were a barcode and its midband were a supermarket scanner. You could imagine that if receptors 1, 6, 7, and 11 go off, the brain recognizes these signals as prey, and the mantis shrimp attacks. If receptors 3, 4, 8, and 9 go off, that might be a mate, and it's a mantis shrimp, since "some very careful wooing ensues," Marshall says. The animal might not even have any conception of color at all.



Each curve represents one of the 12 classes of photoreceptor cells in a mantis shrimp's eye. The peak shows the wavelength of light to which that class is most sensitive.

All of this remains a highly educated guess. None of the stomatopod researchers I spoke to claim to really know what these animals see. It's possible that they might use different kinds of color vision for different tasks. For

recognizing food, as in Thoen's experiment, a 12-color look-up table might suffice. But when recognizing each other, they might use a more conventional system that can discriminate between similar colors. After all, many of them are vividly colored themselves, and display their markings to each other when they meet. "For a mate, maybe the subtleties matter," Cronin says. "But that's a very difficult experiment to do."

Studying animal behavior is always challenging. But studying the behavior of mantis shrimps borders on masochism. In Marshall's lab, as part of a new experiment, Streets has been trying to train the peacock pods to attack zip ties with particular colors on them. But when she demonstrates this for me, the animals consistently make the wrong choice. At one point, one of them punches the wall of the aquarium. Another just air-punches (water-punches?) nothing in particular. I ask Streets if they're hard to train. "Oh my god," she says, shaking her head slightly. They're not motivated by food, because they don't need to eat very often. They seem to lose interest very easily, so she can only test them once a day. "I swear to god they know what the task is but they're just spiteful," Streets says.

"Do you love or hate working with them?" I ask.

"It's mixed," she says, resignedly. "At first, it's super-cool. I'm working with *mantis shrimps*! Everyone who likes this sort of thing has heard of them. But then you start working with them, and you just sit there and wonder why you're doing this."

—

WE, LIKE STREETS, are going to stick with mantis shrimps for a little while longer, because there's even more to their eyes than meets the…well, you know. Indeed, their eyes have proved to be so unusual, so complicated, and so hard to understand that many scientists around the world now study them. Nicholas Roberts and Martin How do so in Bristol, England. They take me to a room where they also have peacock mantis shrimps—eight individuals, which live in separate aquaria for each other's safety. Their tanks are at eye level, which makes it easier to see how inquisitive they are. As we approach, several of them notice and start looking at us. I press a finger against one of the tanks, and a pod named Nigel swims up. I move the finger, and he follows. It feels like I'm dragging him around.

Nigel's eyes are constantly moving, in every conceivable direction. They move up and down, and side to side. They rotate clockwise and anticlockwise.[*20] They rarely move together, or in the same direction. Roberts sometimes does experiments where he films mantis shrimps from above as they look at a screen. "Quite often, they'll have one eye doing the task on its own, and one eye pointed up at the camera," he tells me. As I noted in the previous chapter, we interpret active eyes as a sign of an active mind. But mantis shrimps actually have small, weak brains. The hypermobile nature of their eyes is not a sign of a probing intelligence. But it *is* the key to understanding how and what they see.

Our retinas have cone-rich foveae, where our vision is sharpest and most colorful. We train this zone onto different parts of the world by flicking our eyes from place to place. And when we spot something interesting in our peripheral vision, we redirect our gaze at it to analyze it in detailed color. Mantis shrimps do something similar. The midband sees color, but its view is confined to a thin strip

of space. The hemispheres probably only see in black-and-white, but their view is panoramic. As the mantis shrimp moves its eyes around, it looks for movements and objects of interest with the hemispheres. When it spots something, it flicks its eyes across and scans the midbands over the area, as if waving two supermarket scanners along a shelf. Does the mantis shrimp start with a monochrome view, which it gradually paints with colors? “I don’t think so,” Marshall tells me. He suspects that “they never construct a solid two-dimensional representation of color” in their brains. Instead, as they scan with their midbands, they simply wait for anything that excites the right combination of photoreceptors.

Imagine that you’re a mantis shrimp. It is a truth universally acknowledged that you are in want of something to punch. Your eyes are in constant, uncoordinated motion, the right one perusing one part of the reef, the left glancing somewhere else. Your view is monochrome because what you’re after is not color but movement. You spot it to your right, and flick both your eyes across. They’re scanning together now, sweeping their midbands over the mystery object. Suddenly, photoreceptors 3, 6, 10, and 11 fire. Your brain recognizes a fish. Your arms lash out and hit their mark.

This style of vision is highly efficient, and means less work for the mantis shrimp’s small brain.[*21] But it comes with a catch. It’s very hard to detect movement with an eye that’s also moving. When we walk along a street or stare out a vehicle window, our eyes actually fix on specific points ahead of us, rapidly flicking from one to the next. These flicks, or saccades, are some of the fastest movements we make, which is just as well, because as they’re happening, our visual system shuts down. Our

brains fill the millisecond-long gaps to create a sense of continuous vision, but that's an illusion. The same thing happens to mantis shrimps when they do their slow midband scans. "It could be that in that time, they have to turn off their motion vision," How tells me. "Their eye is moving, the world is blurring, and it's probably harder to see a predator coming in." But when the eye *isn't* scanning, most of the mantis shrimp's view is black-and-white. The jumping spiders we met in the previous chapter split different visual tasks—motion and colorful detail—among separate eyes. The mantis shrimps do the same among different portions of the same eye, and *among different periods of time*. To see movement, they have to give up color. To see color, they give up movement. "It's a time-sharing system," Cronin says. "It's not really one you'd build, but they discovered it and it has worked for them."

By this point, dear reader, you might reasonably be feeling overwhelmed by talk of photoreceptors and midbands and hemispheres and all the other absurd complications that mantis shrimps have packed into their eyes. Or maybe, after all of that, you're feeling a touch of clarity, as if you're on the cusp of imagining the stomatopod Umwelt. In either case, I have bad news for you. *There is more*.

Remember that light is a wave. As it moves, it oscillates. Those oscillations can usually occur in any direction perpendicular to the line of travel, but they're sometimes confined to just one plane—imagine attaching a rope to a wall and then shaking it up and down, or side to side. This kind of light is said to be *polarized,* and it is common in nature. It is formed when light is scattered by water or air, or when it reflects off smooth surfaces like glass, waxy leaves, or bodies of water. Humans are largely oblivious to

polarization, but most insects, crustaceans, and cephalopods can see it in much the same way that they see color. Their eyes typically have two classes of photoreceptors that are stimulated by horizontally or vertically polarized light. By comparing their two receptors, they can distinguish between light that's polarized to different extents, or at different angles. You could call these animals *dipolats.*[*22]

Mantis shrimps have this arrangement in the top hemisphere of their eyes. But in the bottom hemisphere, their polarization receptors are rotated by 45 degrees. And in rows 5 and 6 of the midband, they have something unique. Polarized light usually oscillates in a single fixed plane, but that plane can sometimes rotate, so the light travels along a twisting helix. This is called *circular polarization*. And as Marshall's postdoc Tsyr-Huei Chiou found in 2008, mantis shrimps are the only animals that can see it. The bottom rows of their midbands have photoreceptors that are tuned to circularly polarized light, spiraling either clockwise or anticlockwise. So mantis shrimps have *six* classes of polarization receptors—vertical and horizontal, two diagonals, clockwise and anticlockwise. Ever the exceptions, they are *hexapolats*.[*23]

I have explained polarization and color separately, and these topics often occupy separate chapters in textbooks. But there's no reason to think that mantis shrimps treat them differently. They might well treat the six kinds of polarization signals as yet more colors—more channels of information that they use to recognize objects around them. But why do they need six more, when they already have 12? Why is their vision so inordinately complicated? "There are animals with much simpler visual systems that are very effective on the reef," Tom Cronin tells me. So,

with mantis shrimps, “there remains the question: *What’s it all for?* And no one knows.”

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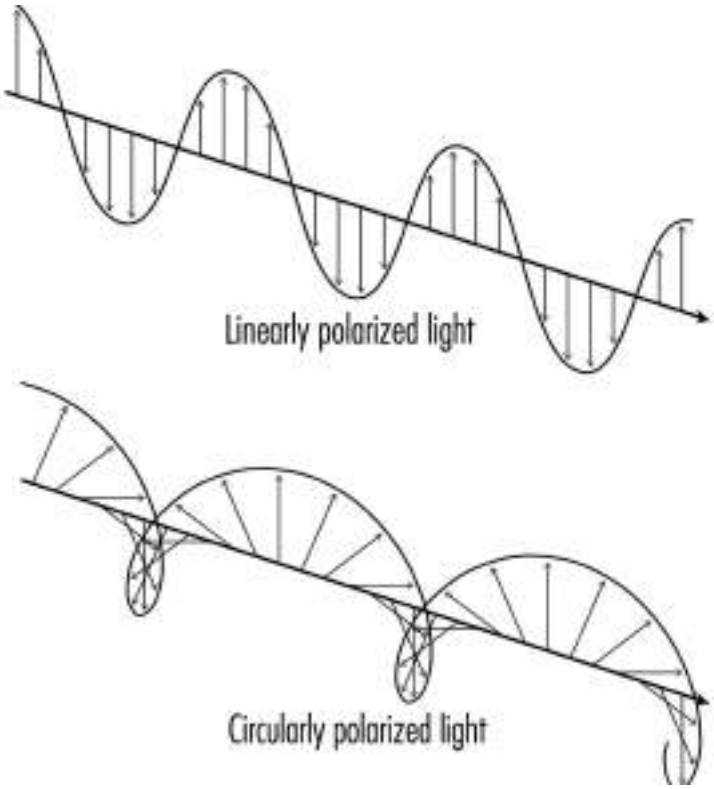
WAIT A MINUTE. Back up a bit. *Why exactly can mantis shrimps see circularly polarized light?*

Unlike linearly polarized light, circularly polarized light is very rare, which is probably why no other animal has evolved the ability to see it. Indeed, the only things in the mantis shrimps’ environment that reliably give off circularly polarized light…are the mantis shrimps themselves. One species reflects it from the large keel on its tail, which males use during courtship. Another reflects it from body parts that it displays to rivals during combat. Perhaps, then, mantis shrimps communicate using a form of light so secretive that only they can see it. There’s something unsatisfyingly circuitous about this explanation, though. Circularly polarized signals would be useless if the mantis shrimps didn’t already have eyes that could see them. But why would those eyes have evolved that ability if there wasn’t anything for them to see? Which came first, the eye or the signal?



Tom Cronin thinks it was the eye. In the bottom two rows of the midband, the photoreceptors are arranged in a way that just happens to untwist circularly polarized light so that it becomes linearly polarized instead. That’s how mantis shrimps can sense it. This arrangement might have been an anatomical fluke—a quirk of their compound eye that gave them the ability to see circularly polarized light, even when there was little of that light around to see. The ancestral mantis shrimps effectively had an accidental sense. They exploited it by slowly developing structures on their shells that reflect circularly polarized light, evolving signals that suited their eyes. This happens a lot. Signals are meant to be seen, and so the colors that adorn the fur, scales, feathers, and exoskeletons of animals are shaped by the colors that the animals’ eyes can perceive. In viewing nature’s paintings, eyes define its palette.

Primates, for example, evolved trichromacy to better spot young leaves and ripe fruits. And once they added red to their Umwelt, they began evolving patches of bare skin that could convey messages by flushing with blood. The red faces of rhesus macaques, the red rumps of mandrills, and the comically red and bald heads of uakaris are all sexual signals made possible by trichromatic vision.

Most of the fish in coral reefs are also trichromats. But since red light is strongly absorbed by water, their sensitivities are shifted toward the blue end of the spectrum. This explains why so many reef fish, like the blue tang that stars in Pixar's *Finding Dory,* are blue and yellow. To their version of trichromacy, yellow disappears against corals, and blue blends in with the water. Their colors look incredibly conspicuous to snorkeling humans, because our particular trio of cones excels at discriminating blues and yellows. But the fish themselves are beautifully camouflaged to each other, and to their predators.

The color vision of predators diversified the patterns of Central America's strawberry poison frog—a single species that comes in 15 incredibly different forms. One is lime green with cyan stockings. Another is orange with black spots. These colors are so varied as to seem almost random, but there's method to the visual madness. These frogs are poisonous, and the most toxic ones are also the most conspicuous. But as Molly Cummings and Martine Maan discovered, they are conspicuous only to birds and not to other predators like snakes. It is likely that tetrachromatic avian eyes drove the evolution of the outlandish amphibian skins. This makes sense: The colors are intended as warnings, and across the generations, frogs whose hues were best suited to the vision of their predators were more likely to go unattacked. And Cummings and

Maan showed that you can work out who those predators are—in this case, birds—by studying the colors of their prey. Since eyes define nature's palette, an animal's palette tells you whose eyes it is trying to catch.

You can apply the same logic to flowers. In 1992, Lars Chittka and Randolf Menzel analyzed 180 flowers and worked out what kind of eye would be best at discriminating their colors. The answer—an eye with green, blue, and UV trichromacy—is exactly what bees and many other insects have. You might think that these pollinators evolved eyes that see flowers well, but that's not what happened. Their style of trichromacy evolved hundreds of millions of years before the first flowers appeared, so the latter must have evolved to suit the former. Flowers evolved colors that ideally tickle insect eyes.

I find these connections profound, in a way that makes me think differently about the act of sensing itself. Sensing can feel passive, as if eyes and other sense organs were intake valves through which animals absorb and receive the stimuli around them. But over time, the simple act of seeing recolors the world. Guided by evolution, eyes are living paintbrushes. Flowers, frogs, fish, feathers, and fruit all show that sight affects what is seen, and that much of what we find beautiful in nature has been shaped by the vision of our fellow animals. Beauty is not only in the eye of the beholder. It arises because of that eye.

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IT'S A SUNNY afternoon in March 2021, and I'm taking Typo, my corgi, for a walk. As we approach a neighbor who is rinsing his car with a hose, Typo stops, sits, and stares. As I wait with him, I notice a rainbow in the water arcing from

the hose. To Typo's eyes, it goes from yellow to white to blue. To mine, it goes from red to violet, with orange, yellow, green, and blue in the middle. To the sparrows and starlings perched in a tree behind us, it goes from red to ultraviolet, with perhaps even more gradations in between.

I noted at the start of this chapter that color is fundamentally subjective. The photoreceptors in our retinas detect different wavelengths of light, while our brains use those signals to construct the sensation of color. The former process is easy to study; the latter is extremely difficult. This tension between reception and sensation, between what animals can detect and what they actually experience, exists for most of the senses. We can dissect a mantis shrimp's eye and work out what every component does, but still never really know how it actually sees. We can work out the exact shape of the taste receptors on a fly's feet without ever understanding what it experiences when it lands on an apple. We can chart how an animal reacts to what it senses, but it's much harder to know how it *feels*. And that distinction becomes especially difficult—and important—when thinking about pain.

SKIP NOTES

*1 Technically, based on the wavelengths of light that most excite them, the long and short cones should really be called yellow-green and violet instead of red and blue.

*2 The firefly squid is an exception. It's the only cephalopod known to have three different classes of photoreceptors, and may well have color vision.

*3 Both medium and long genes lie on the X chromosome. If someone with two X chromosomes inherits a faulty copy of either gene, they usually have a working backup. But if someone with an X and a Y chromosome inherits a faulty copy, they're stuck with it. This is why red-green color-blindness, which

is typically caused by the loss of either the M or L cones, is much more common in men than in women.

*4 Kentaro Arikawa, who studies color vision, first realized that he has a red-green color deficiency when he was six; his mother asked him to pick strawberries from their garden for breakfast and he failed, disappointing her. In several lab experiments, trichromats do outperform dichromats at finding fruit.

*5 Primates also have unusually acute vision, which might explain why trichromacy didn't evolve in other fruit- or leaf-eating mammals. "You can give a mouse trichromacy, but what good would that be to a nocturnal mammal with poor acuity?" says Melin. By contrast, sharp-eyed primates can use trichromacy to spot fruit and young leaves from afar, and reach them before competitors realize they have appeared.

*6 Howler monkeys are the exception. They live in the Americas, but unlike the other monkeys they share a continent with, they are all trichromatic, males and females. That's because they evolved trichromacy in the same way as their cousins in Africa and Eurasia—by duplicating the long-opsin gene. And they did so independently.

*7 It's even more complicated than this, because many of these American monkeys have three possible versions of the same gene. Females might inherit two of the three versions or a pair of the same ones, which means that these animals have six different forms of color vision—three dichromacies and three trichromacies.

*8 Visible light is just a small part of the vast electromagnetic spectrum, and there are reasons it's the only slice that our eyes can detect. Electromagnetic waves with very short wavelengths, like gamma rays and X-rays, are largely absorbed by the atmosphere. Those with very long wavelengths, like microwaves and radio waves, don't have enough energy to reliably excite opsins. For these reasons, no animal can see microwaves or X-rays. There's only a narrow Goldilocks zone of wavelengths that are useful for vision, and they range from 300 to 750 nanometers. Our eyes, which work from 400 to 700 nanometers, already cover much of that available visual space. But in the margins, a lot can happen.

*9 Why don't most humans see UV? It might be the cost of having sharp eyesight. When light passes through our lenses, shorter wavelengths are bent at sharper angles. Even if the lens admitted UV, it would focus these wavelengths at a point well in front of the others, blurring the image on the

retina. This is called chromatic aberration. It's less of an issue for small eyes, or for those that don't need to be very acute. But for big-eyed animals with sharp vision, it's a problem. This may be why primates don't see UV, and why raptors see much less of it than other birds.

*10 Some scientists think that the first kind of color vision to evolve was dichromacy with a green photoreceptor and a UV one. If that's true, animals have been seeing UV for as long as they've been seeing color.

*11 Other claims about UV vision have also fallen apart. In 1995, a Finnish team suggested that kestrels can track voles by looking for UV reflecting off their urine. This claim has been frequently repeated in books and documentaries, but "it's wrong," says Almut Kelber. In 2013, she and her colleagues showed that vole urine doesn't actually reflect much UV and isn't distinguishable from water. Kestrels can't possibly see it from afar.

*12 If Stoddard set both lights to produce the same colors, the hummingbirds could no longer reliably arrive at the nectar-baited feeder. This suggests that they're not just learning the position of the right feeder, or relying on other senses like smell.

*13 I am still hung up on whether UV-purple should be called ultrapurple or purpurple.

*14 There's another twist to this story, which readers of my first book, *I Contain Multitudes,* will be delighted by. Every now and then, Briscoe would find a female erato with male-like eyes that only had three opsins. This pattern confused her, until she realized that all of these females were infected by a bacterium called *Wolbachia*. *Wolbachia* is one of the most successful bacteria on the planet, and infects a huge proportion of insects and other arthropods. It only passes down the female line from mother to daughter, and has many tricks for doing away with useless males. Sometimes it kills males outright. Sometimes it transforms them into females. Sometimes it allows females to reproduce asexually without needing males at all. What it's doing in erato is a mystery, but one that Briscoe is now trying to solve.

*15 Note that cDa29 and other genuine tetrachromats can't see ultraviolet like birds can, so their vision would cover the same range of wavelengths as a normal trichromat's. They still see an extra dimension of color, and their color space can still be represented by a pyramid instead of a triangle. But it's a pyramid that fits inside the one that birds have.

*16 In 2019, Jordan developed a test that could quickly tell if women have a fourth cone with exactly the right 12-nanometer spacing to offer true tetrachromacy. “That would allow us to go around and very quickly find out how many of them there are,” she says. “And then COVID-19 came.”

*17 Amanda Melin tells me that human color vision is far more varied than what she and others have seen in chimps, baboons, and other primates. It’s unclear why, but it might be that our survival is now less closely tied to the colors we see, allowing for variants that might once have been detrimental to remain.

*18 The colored blobs that Marshall first noticed are found in rows 2 and 3. As he suspected, they do act as filters, but their job is to sharpen the sensitivity of the underlying photoreceptors.

*19 You might have read that they have 16 photoreceptor classes. Aside from the 12 in the first four rows of the midband, there are two in the last two rows, and two more in the hemispheres. As far as anyone knows, these other four are not involved in color vision. Also, not all mantis shrimps have 12 classes. While most species live in colorful shallows, some inhabit deeper waters and have lost all but one or two of their photoreceptor classes.

*20 While we can perceive depth by comparing the images from our two eyes, a mantis shrimp can do the same with the three zones of a single eye. Each eye has trinocular vision and can gauge distance independently of its twin. This is a handy skill for a pugnacious animal that often loses one of its eyes in combat.

*21 Imagine that you’re trying to build a robot that can sneak into a local diner and find a hamburger for you. You could equip that robot with two state-of-the art cameras and an algorithm that can learn to analyze and classify the images from those cameras. But “surely it’s better to just build a hamburger-detector,” Marshall says. “And the best way to do that is to build a line-scan device. It’s much more efficient.”

*22 Cephalopods are more sensitive to polarization than any other animals. Shelby Temple and his colleagues found that the mourning cuttlefish can spot the difference between two kinds of polarized light whose planes of vibration differ by just one degree. These animals are color-blind, but they might use polarization as a replacement, to add rich detail to their visual world.

*23 They can also rotate their eyes to enhance the polarization contrast between an object and its background, making them the first known animals with dynamic polarization vision.

4.

The Unwanted Sense

Pain

IN A WARM ROOM THAT smells sweetly of corn, I'm holding a small rodent in my gloved hand. Pink and mostly hairless, it seems less like a rat or guinea pig and more like a finger that's been soaking in a bath too long. It almost looks embryonic, even though it is a fully grown adult. Its eyes are black pinpricks. Its long incisors stick out in front of its lips. Its loose skin feels tough but is so translucent that I can make out its internal organs, including the dark outline of its liver. It is a naked mole-rat. Its appearance is the least strange thing about it.[*1]

Naked mole-rats are exceptionally long-lived for rodents, with life spans of up to 33 years. Their lower incisors can splay apart and come together to grasp objects. Their sperm are misshapen and sluggish. They can survive for up to 18 minutes without oxygen, a hardship that no mouse can endure for more than a minute. They live in cooperative colonies like those of ants and termites, with one or more breeding queens and dozens of sterile workers. A single naked mole-rat, like the one I am holding, is an unusual sight. So is a naked mole-rat in the open. They normally live within labyrinthine underground tunnels, which they constantly expand, remodel, and patrol in their quest for nutritious tubers. Thomas Park replicates this network in his Chicago-based lab with interconnected plastic cages filled with toilet paper rolls and wood chips. Some of the mole-rats are instinctively chewing the walls of

these containers in a bid to expand their artificial tunnels, and kicking their legs back as if removing loosened dirt. Others are resting in the nesting chamber, a pile of wrinkled bodies curled around their queen. She is much larger than they are, and her belly bulges with unborn pups. “For naked mole-rat people, that’s a beautiful sight,” Park tells me. I take his word for it.

In their wild burrows, naked mole-rats also sleep in large huddled piles to keep warm. Those at the bottom rapidly run out of oxygen, which is probably why they have evolved to withstand the gas’s absence. They’ve also been forced to tolerate carbon dioxide, which builds up in the nesting chambers with every exhalation. Carbon dioxide normally makes up 0.03 percent of the air in an average room. If levels shot up to 3 percent, you’d hyperventilate and panic. Meanwhile, the gas would dissolve in the wet surfaces of your mucous membranes, acidifying them. Your eyes would sting. Your nose would burn. You’d wince in distress. You’d try to get away. But a naked mole-rat wouldn’t flee or flinch.

Park demonstrated this with an arena that’s infused with carbon dioxide at one end and regular air at the other. A mouse would scurry to the latter region. But naked mole-rats were comfortable in the thick carbon dioxide, moving away only when levels reached a preposterous 10 percent. They simply don’t find acids painful. They’ll sniff strong vinegary fumes with no sign of discomfort. They don’t register drops of acid beneath their skin—the equivalent of squirting lemon juice into a cut in your hand. And they’re similarly unperturbed by capsaicin, the chemical that gives chili peppers and pepper spray their burn. While capsaicin inflames our skin, leaving it hypersensitive to heat, it has no such effect on naked mole-rats. It’s not that these

animals can’t feel pain, as is commonly said. They dislike pinches and burns, and they’ll recoil from the chemical responsible for mustard’s sting. But they’re oblivious to several noxious substances that we find painful.

Our experience of pain depends on a class of neurons called nociceptors. (The word is pronounced with a soft *c,* and comes from the Latin word *nocere,* meaning “to harm.”) The naked tips of these neurons pervade our skin and other organs. They are loaded with sensors that detect harmful stimuli—intense heat or cold, crushing pressures, acids, toxins, and chemicals released by injuries and inflammation.[*2] Nociceptors vary in their size, how excitable they are, and how quickly they transmit information—qualities that collectively sculpt a landscape of pricks, stabs, burns, throbs, cramps, and aches that we are unfortunate enough to experience.

Almost all animals have nociceptors, and naked mole-rats are no exception. But theirs are fewer in number and have been disabled in several ways. Those that would normally be activated by acids are instead blocked by them. Those that detect capsaicin still do so, but don’t produce the neurotransmitters that normally convey their signals to the brain. Some of these changes seem easy to explain: If naked mole-rats could still feel acidic pain, the carbon dioxide in their nesting chambers would probably lead to an agonized sleep. “But we don’t know why they can’t respond to capsaicin,” Park tells me. Perhaps they eat an especially spicy tuber to which they’ve become resistant? Or perhaps it was the opposite: After millions of years in a relatively safe environment, they simply lost sensory abilities that they no longer needed. Either way, their imperviousness tells us that there’s nothing inherently painful about either capsaicin or acids.

Several hibernating mammals that, like the naked mole-rat, must deal with building levels of carbon dioxide are also insensitive to acids. Birds that carry the seeds of pepper plants don't feel the burn of capsaicin. Humans are insensitive to nepetalactone, a chemical produced by the catnip plant that is intensely irritating to mosquitoes. The grasshopper mouse, a surprisingly ferocious predator of scorpions, can shrug off stings that feel to humans like cigarettes being stubbed out on our skin. The mouse's nociceptors have evolved to *stop* firing when they recognize a scorpion's toxins, turning venom that would normally be excruciating into a painkiller.

People often assume that pain feels the same across the entire animal kingdom, but that is not true. Much like color, it is inherently subjective and surprisingly variable. Just as wavelengths of light aren't universally red or blue, and odors aren't universally fragrant or pungent, nothing is universally painful, not even chemicals in scorpion venom that specifically evolved to inflict pain. Pain, in warning animals of injury and danger, is crucial to their survival. And while all animals have things to be wary of, they differ in what they must avoid and what they must tolerate. That makes it notoriously tricky to tell what an animal might find painful, whether an animal is experiencing pain, or whether it even can.

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IN THE EARLY 1900s, the neurophysiologist Charles Scott Sherrington noted that the skin has "a set of nerve-endings whose specific office it is to be amenable to stimuli that do the skin injury." Those nerves would "evoke skin pain" if connected to the brain, but they could still trigger

defensive reflexes “devoid of psychical feature” if said connections were cut. A dog, for example, would still pull its paw away from a hard squeeze even after a spinal injury. Sherrington wanted a separate term to describe the act of sensing harmful stimuli as distinct from the painful feelings they produce—a term that would have “the advantage of greater objectivity.” He came up with *nociception*.

Over a century later, scientists and philosophers still make the distinction between nociception and pain. Nociception is the sensory process by which we detect damage. Pain is the suffering that ensues. Last week, when I accidentally touched a hot pan, the nociceptors in my skin sensed the scalding temperatures. That’s nociception, which triggered a reflex that forced my arm to withdraw *before I realized what was happening*. Shortly after, signals from those nociceptors reached my brain, which produced feelings of discomfort and distress. That’s pain. The two are intimately linked but also distinct. Nociception occurred in my hand (and spinal cord); the pain was produced by my brain. They are the sensory and emotional halves of a process that, to most of us, feel inseparable.

But they *can* be separated. Amputees who feel the phantom remnants of their old limbs can experience pain without nociception. Other people are congenitally indifferent to pain—from birth, they’re aware of sensations that others would find painful, but aren’t distressed by them.[*3] Some painkillers duplicate this effect by acting on the central nervous system to dull pain without affecting nociception. “I took Vicodin after having surgery on my jaw,” Robyn Crook, a neuroscientist who studies pain, tells me. “I would still be fully aware that the sensation was there, but I felt very serene about it.” People can also learn

to ignore or even enjoy things that trigger nociceptors, like mustard, chilies, or intense heat.[*4]

To be clear, the separation between nociception and pain does not make the latter any less real. People (and especially women) with chronically painful disorders have long been disbelieved and neglected by the medical establishment. They've been wrongly told that their suffering is just in their heads, or the result of mental health problems like anxiety. Pain is easy to dismiss in this way because it is subjective. And thanks to the unfortunate persistence of dualism—the outdated belief that the mind and body are separate—people often equate *subjective* with *woolly,* and *psychological* with *imagined.* This is harmfully wrong. It's not the case that nociception is a physical process of the body, while pain is a psychological process of the mind. Both arise from the firing of neurons. It's just that in humans, nociception can be confined to the peripheral nervous system, while with pain, the brain is always involved. Pain requires some degree of conscious awareness. Nociception can exist without it.

Nociception is an ancient sense. It is so widespread and consistent across the animal kingdom that the same chemicals, opioids, can quell the nociceptors of humans, chickens, trout, sea slugs, and fruit flies—creatures separated by around 800 million years of evolution. But since pain is subjective, it is difficult to tell which creatures have it. Humans can barely do that with each other. "You can tell me you have a screaming headache and I'd have no idea what that means for you," Crook tells me, "and we're the same species, with brains that are basically the same." Scientists who study human pain still largely rely on people's own accounts, and animals obviously can't talk

about their feelings.[*5] Our only recourse is to read the tea leaves of their behavior.

Pinch the foot of a mouse (or naked mole-rat) and it will pull its limb away, and probably lick and groom it. Offer painkillers and it will accept. These actions resemble what a hurt human might do, and since a rodent's brain is similar enough to ours, we can reasonably guess that its nociceptive reflex is accompanied by pain. But such arguments by analogy are always fraught, especially when it comes to animals with very different bodies and nervous systems. A leech will writhe when pinched, but are those movements analogous to human suffering, or to an arm unconsciously pulling away from a hot pan? Other animals may hide their pain. Social creatures can call for help by whining when they're injured, but an anguished antelope would likely keep quiet lest its distress calls convey weakness to a lion. The signs of pain vary from one species to another. How, then, do you tell if an animal is experiencing it?

For many historical thinkers, who believed animals incapable of emotions or conscious experiences, the question was irrelevant. The seventeenth-century dualist René Descartes thought of them as automata. Paraphrasing his views, the philosopher and priest Nicolas Malebranche wrote that "animals eat without pleasure, cry without pain, grow without knowing it: they desire nothing, fear nothing, know nothing." Such views have changed in recent decades, and most scientists would now agree that mammals can feel pain. But fierce debates are still raging around other animal groups, including fish, insects, and crustaceans.[*6] At the core of these lingering controversies is the distinction between nociception and pain. That distinction "is a relic of attempts to emphasize differences

between humans and other animals or between ‘higher’ and ‘lower’ animals,” wrote Donald Broom, a biologist who specializes in animal welfare. After all, in other senses, the actions of sensory receptors and the subjective experiences produced by the brain don’t get different names. Scientists who study eyes don’t get into arguments about whether humans have vision and fish merely have photoreception.

But as we saw in the earlier chapters, there *is* a difference between what the cells in a retina detect and the conscious experience of seeing. Vision scientists *do,* in fact, make distinctions between simple photoreception and spatial vision—remember the four stages of Dan-Eric Nilsson’s model of eye evolution. They suspect that some creatures, like scallops, might stretch our concept of vision by seeing without scenes. They recognize that some aspects of our visual world, like colors, are constructs of the brain, and that some animals that can sense different wavelengths of light, like mantis shrimps, might not perceive colors at all.

In the chemical senses—smell and taste—it’s also possible to sense and react to a stimulus without being aware of it. You’re doing it right now. Humans have taste receptors throughout our bodies—not over our skin or feet, but in our internal organs. Sweet receptors in our gut control the release of appetite-controlling hormones. Bitter receptors in our lungs recognize the presence of allergens and trigger an immune response. All of this happens without us knowing. Similarly, the taste receptors on a mosquito’s foot could trigger a reflex that makes it withdraw from DEET without ever passing information to the insect’s brain. The taste receptors on a fly’s wing can initiate a grooming reflex if they detect microbes, without the fly needing to know what a microbe or a wing is. To an

observer, those behaviors look remarkably like disgust, but we have no idea if such emotions are playing out in the insect's brain.

Broom is right that we rarely distinguish between the raw act of sensing and the subjective experiences that ensue. But that's not because such distinctions don't exist. It's because they usually don't matter. Questions about what a scallop sees, or whether birds and humans see the same red, are philosophically interesting. But the distinction between pain and nociception is a morally, legally, and economically vital matter, which affects our cultural norms around catching, killing, eating, or experimenting on animals. Pain (or nociception, if you prefer) is the unwanted sense. It is the only one whose *absence* (in naked mole-rats or grasshopper mice) feels like a superpower. It is the only one that we try to avoid, that we dull with medication, and that we try to avoid inflicting upon others.

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SCIENTISTS WHO WORK on vision or hearing can play images and sounds at the animals they're studying. But those who study pain have to harm the creatures they work with in the pursuit of knowledge that might improve the welfare of those same creatures. They want to use as few animals as possible, but have to use enough that their results are statistically sound. Their work is morally challenging and often frustrating. "People either feel that animals absolutely feel pain like we do so it's a stupid question to research, or that they don't feel pain like we do so it's a stupid question to research," Robyn Crook tells me.

“There’s not a lot of middle ground where people are agnostic.”

Fish exemplify the fraught nature of pain research. In the early 2000s, Lynne Sneddon, Mike Gentle, and Victoria Braithwaite injected trout in the lips with bee venom or acetic acid, the substance that gives vinegar its kick. Unlike fish that had been injected with saline, these unfortunate individuals began breathing heavily. They stopped eating for several hours. They lay on the gravel bottoms of their tanks and rocked from side to side. Some of them rubbed their lips against the gravel or the walls of their tanks. They no longer kept their distance from unfamiliar objects, as if something was distracting them—an effect that vanished when they were injected with morphine. Sneddon and her colleagues couldn’t see how these actions, which persisted well after the injections, could be attributed to mere nociception. They saw animals in pain.

These studies, published in 2003, were groundbreaking. Scientific texts, angling magazines, and Nirvana lyrics had all promulgated the belief that fish don’t feel pain. The struggles of a hooked fish were meant to be simple reflexes, rather than signs of suffering. No one even knew if fish had nociceptors, until Sneddon’s team confirmed that they do. She tells me that when she began her work, she would ask veterinary students or angling groups if fish experience pain. “A few people would say yes,” she says. Now, after 17 years of mounting evidence, “pretty much everyone puts their hand up.”

When fish nociceptors fire, the signals travel to parts of the brain that deal with learning and other behaviors more complex than simple reflexes. Sure enough, when the animals are pinched, shocked, or injected with toxins,

they'll behave differently for hours or days—or until they get painkillers. They'll make sacrifices to get those drugs, or to avoid further discomfort. In one experiment, Sneddon showed that zebrafish prefer to swim in an aquarium full of plants and gravel than in one that's empty. But if she injected the fish with acetic acid and dissolved a painkiller in the water of the barren aquarium, they abandoned their normal preferences and chose the boring but soothing environment instead. In another study, Sarah Millsopp and Peter Laming trained goldfish to feed in a specific part of an aquarium, and then gave them an electric shock. The fish fled and stayed away for days, forgoing food in the process. They eventually returned, but did so more quickly if they were hungry or if the shock had been mild. Their initial escape might have been reflexive, but they then weighed up the pros and cons of avoiding further harm. As Braithwaite wrote in her book, *Do Fish Feel Pain?,* " There is as much evidence that fish feel pain and suffer as there is for birds and mammals."

But a group of vocal critics remains unconvinced.[*7] They accuse Sneddon and others of anthropomorphism, and seeing the fish in their studies through human eyes. More likely, they argue, those fish were behaving unconsciously. After all, their brains are capable of little else. Our brains are topped by a thick mushroom cap of neural tissue called the neocortex. It's organized like an orchestra, with many specialized sections that act together to produce the music of consciousness and the lament of pain. But fish brains lack a neocortex, much less a highly organized one. " Fishes are neurologically equipped for unconscious nociception and emotional responses, but not conscious pain and feelings," seven skeptics wrote in 2014, in a paper entitled "Can Fish Really Feel Pain?"

Ironically, this argument is itself grossly anthropomorphic. It blithely assumes that the neocortex must be necessary for pain in all animals, since that's the case in humans. But if that's true, then birds can't feel pain, either, since they also lack a neocortex. And by the same faulty logic, fish must lack all the other mental skills that are rooted in the neocortex, like attention, learning, and many of the other abilities that they plainly possess. Animals often evolve different solutions to the same problems, and different structures for the same tasks. To argue that fish can't feel pain because they lack a human-like neocortex is like saying that flies cannot see because they lack camera eyes.

The critics do have a point, though: We cannot assume that all animals are capable of pain or other conscious experiences. Consciousness isn't an inherent property of all life. It arises from nervous systems, and while those systems might not need a neocortex, they do need enough processing power. For perspective, crabs and lobsters use a cluster of about 30 neurons to control the rhythmic movements of their stomachs. Meanwhile, the nematode worm *C. elegans* has 302 neurons in total. Can the worm produce subjective experiences with just 10 times as many neurons as a crab needs to churn its stomach? That doesn't seem likely. "At some point the nervous system is just too small," says Robyn Crook. "But how much brainpower is enough?" Is it the 86 billion neurons of humans, the 2 billion of a dog, the 70 million of a mouse, the 4 million of a guppy, or the 100,000 of a fruit fly? Crook doubts that the 10,000 neurons of a sea slug are enough, but "it's not like someone can say you need 10,057 neurons," she tells me.

What matters is not just the total tally of neurons but the connections between them. In human brains, hundreds of

thousands of neurons connect the different sections of our cortical orchestra. These links allow us to play the full symphony of a painful experience, melding sensory cues with negative emotions, bad memories, and more. But such links are much sparser in the brains of insects. A fruit fly's nociceptors connect to a part of the brain called the mushroom body, which is critical for learning. But the mushroom body only has 21 output neurons that lead to other brain regions. The fly may well learn to avoid a nociceptive stimulus, but do those lessons come with the bad feelings that are so inherent to human suffering? Insects might not even have a brain region that processes emotions, like the amygdala does in humans. "That makes it difficult to understand what the subjective experience of pain would be like in an insect," Shelley Adamo, a physiologist who studies insect behavior, tells me.

Then again, Adamo adds, how would you know what an insect's emotional center looks like? Given how little we know about how *human* brains work, let alone how those of other animals are wired, it feels premature to make definitive proclamations about whether any neurological feature is necessary for experiencing pain. And some animals seem to overperform the limits of their simple brains.

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IN 2003, AT a pub in Killyleagh, Northern Ireland, the biologist Robert Elwood bumped into celebrity chef Rick Stein. "We've got a mutual interest in crustaceans: I study their behavior and you cook them," Elwood remembers saying. And Stein immediately asked, "Do they feel pain?" Elwood didn't think they could, but he didn't really know.

Afterward, the question gnawed at him, and he started trying to answer it. “I thought it would be a quick project, and we could move on,” he tells me. “It didn’t turn out that way.”

Elwood studied the common hermit crab, which frequents European beaches and tucks its soft abdomen into empty seashells. These shells are valuable property, and the crabs are vulnerable without them. But Elwood and his colleague Mirjam Appel found that they will nonetheless evacuate if given a small electric shock. These flights looked reflexive, but the crabs didn’t always flee. It took a stronger shock to force them out of their favored periwinkle shells than it did to evict them from the less desirable flat-top shells. And they were half as likely to abandon their shells if they could smell the scent of predators in the water. “That told me that this isn’t a reflex,” Elwood says. Instead, evacuation is a decision the crabs make after weighing up several sources of information.

The crabs also behaved differently long after the shocks. After fleeing, they wouldn’t return to their shells, despite being dangerously exposed. They groomed the part of their abdomens that got shocked. And even when they didn’t relinquish their shells, they were quicker to accept a new one without the usual careful investigations. These data, Elwood says, are consistent with the idea of pain, but it’s impossible to know what crustaceans are really feeling. “I’m often asked if crabs and lobsters feel pain,” he tells me, “and after 15 years of research, the answer is maybe.”

Crustaceans are the evolutionary cousins of insects and have similarly simple nervous systems. And yet, Elwood’s crabs behaved in apparently complex ways. How do we reconcile that inconsistency? If an animal’s actions don’t

match what its brain is theoretically capable of, are we overinterpreting its behavior or underestimating its nervous system? Sneddon and Elwood argue that it's the latter. Adamo would say it's the former. And it really isn't clear who is right, or if they all are.[*8]

"Fussing about the size of the brain may be a red herring," Adamo tells me. Instead, she prefers to think about the evolutionary benefits and costs of pain. By costs, she means energy, not agony. Evolution has pushed the nervous systems of insects toward minimalism and efficiency, cramming as much processing power as possible into small heads and bodies. Any extra mental ability—say, consciousness—requires more neurons, which would sap their already tight energy budget. They should pay that cost only if they reaped an important benefit. And what would they gain from pain?

The evolutionary benefit of nociception is abundantly clear. It's an alarm system that allows animals to detect things that might harm or kill them, and take steps to protect themselves. But the origin of pain, on top of that, is less obvious. What is the adaptive value of suffering? Why should nociception *suck*? Some scientists suggest that unpleasant emotions might have intensified and calcified the effect of nociceptive sensations, so that animals not only avoid what is currently hurting them but also learn to avoid it in the future. Nociception says, "Get away." Pain says, "…and don't go back." But Adamo and others argue that animals can learn to avoid dangers perfectly well without needing subjective experiences. After all, look at what robots can do.

Engineers have designed robots that can behave as if they're in pain, learn from negative experiences, or avoid artificial discomfort. These behaviors, when performed by

animals, have been interpreted as indicators of pain. But robots can perform them without subjective experiences. This is not to claim, as Descartes did, that animals are unthinking, unfeeling automata; as Adamo says, “No robot is as sophisticated as an insect.” Her point is that insect nervous systems have evolved to pull off complex behaviors in the simplest possible ways, and robots show us how simple it is possible to be. If we can program them to accomplish all the adaptive actions that pain supposedly enables without also programming them with consciousness, then evolution—a far superior innovator that works over a much longer timeframe—would surely have pushed minimalist insect brains in the same direction. For that reason, Adamo thinks it’s unlikely that insects (or crustaceans) feel pain. Or, at least, their experience of pain is likely to be very different from ours. The same goes for fish. “I would expect they have *something,* but what?” she says. “It’s probably not the same.”

This point is crucial. The controversies about animal pain often assume that they either feel exactly what we feel or nothing at all, as if they’re either little people or sophisticated robots. This dichotomy is false, but it persists because it’s difficult to imagine an intermediate state. We know that some people have different *thresholds* of pain than others, just as we know that some have blurrier vision. But a qualitatively different version of pain is as conceptually challenging as a scallop’s scene-less vision. Could pain exist without consciousness? If you strip the emotion out of pain, are you just left with nociception, or a gray area that our imaginations struggle to fill? Perhaps more than for other senses, it is easy to forget that pain can *vary,* and hard to conceive of how it might.

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IN SEPTEMBER 2010, the European Union extended its regulations on animal research to cephalopods—the group that includes octopuses, squid, and cuttlefish. Being invertebrates, cephalopods aren't usually covered by laws that protect the welfare of backboned lab animals like mice or monkeys. But they also have much larger nervous systems than most invertebrates—500 million neurons in an octopus, compared to 100,000 in a fruit fly. They show intelligent and flexible behaviors that surpass those of some vertebrates like reptiles and amphibians. And, as the EU noted in its directive, "there is scientific evidence of their ability to experience pain, suffering, distress and lasting harm." That statement came as a surprise to Robyn Crook, who had worked with cephalopods and knew of no such evidence. The EU seemed to have assumed that apparently intelligent animals must be capable of suffering. But at the time, no one even knew if they had nociceptors, let alone if they experienced pain. "There was a huge disconnect between what science knew at that point and what legislators presumed science knew," Crook tells me.

She began to bridge that gap, starting with the longfin squid—a foot-long species that is commonly fished in the North Atlantic. This animal frequently loses the tips of its arms, either to aggressive rival squid or to the pincers of crabs. Crook mimicked these wounds with a scalpel. As expected, the squid jetted away while releasing clouds of distracting ink, and changed colors to blend in with their surroundings. A few days later, they were still quicker to flee and hide. But surprisingly, they never touched, groomed, or cradled their wounds, the way humans, rats, and even hermit crabs do. They could easily reach their

stump with any of their other seven arms, but they didn't try.

Even more surprisingly, Crook found that injured squid behave as if their entire bodies were sore. When humans and other mammals get cut or bruised, the damaged area is painful but the rest of the body isn't. If I singe my hand, it hurts when I prod the burn but not when I poke my foot. But when Crook damaged one of the squid's fins, the nociceptors on the opposite fin were just as excitable as those on the wounded side. Imagine if your entire body became delicate to the touch whenever you stubbed your toe: That's a squid's reality. "When they're injured, their whole body becomes hypersensitive," Crook tells me. "They go from being normal to this potential world of pain." This might explain why they don't groom their wounds. They can sense that they've been hurt, but they might not be able to tell *where.*

For mammals, the localized nature of pain allows us to protect and clean vulnerable body parts, while getting on with the rest of our lives. Why should squid lack such a useful source of information? One possibility, Crook says, "is that everything in the ocean will eat a squid." Injured squid are especially attractive to predatory fish, either because they are more conspicuous or because they look (or smell) like easier prey. By setting their entire bodies on high alert, they might be better at evading attacks that could come from any direction.[*9] Body-wide sensitivity also makes sense for animals that cannot physically reach most of their bodies. What good would it do them to know that a fin has been injured when they can't do anything about it?

Octopuses are different. Unlike squid, they *can* touch every part of their bodies. They can even reach inside

themselves to groom their own gills—the equivalent of a human putting a hand down their throat to scratch their lungs. And unlike squid, which are stuck in open-water groups and can't take a day off, octopuses can hole up in solitary dens until they feel better. Since they have the time and dexterity to tend to their injuries, it would make sense for them to know where their wounds are. And as Crook showed, they do. Octopuses will sometimes break off an arm if its tip is injured. When that happens, the stump will be more sensitive than the arms around it, and octopuses will cradle that stump in their beaks. In her latest study, published in 2021, Crook found that octopuses will avoid places where they've been injected with acetic acid, but gravitate to places where they receive painkillers. And once they're injected with local anesthetic, they stop grooming their injured arms. In her latest paper, Crook is unambiguous: "Octopuses are capable of experiencing pain."

Even before that study was published, Crook told me that she runs her lab on the assumption that cephalopods feel pain. She does studies that could improve cephalopod welfare, like checking if anesthetics work on them. She uses as few animals as possible (while still being statistically robust) and ensures that their injuries are minimal. Thinking through the ethics of animal research, especially when that research is about pain, is not easy, "but I think it *should* be hard," she says. "You should be distressed by what you're doing to an animal in an experiment, even if it's not painful. Animals don't sign up for this. Even if my broader goal is to alleviate animal suffering, the animal sitting in the tank doesn't know that."

Many scientists who study pain feel the same. They argue that whether cephalopods, fish, or crustaceans feel

what humans do or experience something radically different, there is enough evidence to invoke the precautionary principle. “It’s highly possible that these animals can suffer,” Elwood says, “and we should consider ways of avoiding that suffering.”

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THE MANY DEBATES about pain in animals often revolve around a simple question: *Do they feel it?* And lurking behind that question are several implicit ones. *Is it okay to boil a lobster? Should I stop eating octopus? Can I go fishing?*[*10] When we ask if animals can feel pain, we’re asking less about the animals themselves, and more about *what we can do to them*. That attitude limits our understanding of what animals actually sense.

There is much more to pain than its presence or absence. Shelley Adamo is right that we need to understand more about its benefits and costs. Pain does not exist for its own sake. There’s no reason why anything should hurt. Things hurt so that animals can do something with that information. And without understanding their needs and their limitations, it’s hard to interpret their behavior correctly.

Insects, for example, often do alarming things that seem like they should be excruciating. Rather than limping, they’ll carry on putting pressure on a crushed limb. Male praying mantises will continue mating with females that are devouring them. Caterpillars will continue munching on a leaf while parasitic wasp larvae eat them from the inside out. Cockroaches will cannibalize their own guts if given a chance. These behaviors “strongly suggest that if a pain sense is present, it is not having any adaptive influence on

the behavior," wrote Craig Eisemann and colleagues in 1984. But maybe they simply show what insects are willing to endure? Maybe cockroaches and mantises prioritize protein and procreation over pain, tolerating it in the same way that athletes and soldiers can in the middle of competition or combat. Perhaps caterpillars don't feel the pain of being eaten alive because they can't alleviate that pain.

Consider also the squid and octopuses. Both are cephalopods, but they've been evolving separately for more than 300 million years, roughly the same amount of time that separates mammals and birds. Their bodies and lifestyles are utterly different, so it's no surprise that their nervous systems function very differently after injury. Rather than asking if cephalopods experience pain, we might ask *which ones* experience it, *and how*. The same goes for the 34,000 known species of fish, the 67,000 known species of crustaceans, and the who-knows-how-many-million species of insects. It's ridiculous to treat these groups as monolithic when we know, from other senses like vision and smell, that even closely related animals differ in how they perceive the world.

Instead of focusing on whether pain even exists, we might ask, as physiologist Catherine Williams told me, "In which conditions and from which stimuli is it an advantage to have it, experience it, and display it?" And we would find that pain manifests differently in a burrowing mole-rat than in a scorpion-hunting mouse, or in a long-armed octopus than in a short-armed squid. We might possibly find different forms of pain in sociable animals that can call for help or solitary ones that must fend for themselves, or in short-lived animals that have few chances to repeat their mistakes versus long-lived ones that have many chances to.

And we would certainly learn that pain can vary in animals that must tolerate extremes of temperature, from baking heat to freezing cold.

SKIP NOTES

*1 Naked mole-rats are so weird that their bizarre traits have often been mythologized, and many of the claims that surround them are untrue. I highly recommend the paper “Surprisingly Long Survival of Premature Conclusions About Naked Mole-Rat Biology,” which is an important corrective to some of these myths.

*2 Unlike vision, smell, and hearing, which detect specific stimuli—light, molecules, sound—nociception detects a class of very different stimuli that are united by their potential to cause harm. It’s a mishmash sense, combining elements of smell, which we’ve already explored, and others, like touch, that we are about to.

*3 This condition can be dangerous. Children and babies who have it don’t learn that injuries are dangerous, and often bite their own fingers, bang their heads against objects, or scald themselves. Those who survive are sometimes exploited. The first documented case of congenital indifference to pain was a man who made a living at a circus, as a human pincushion. One Pakistani boy who had the condition would perform on the streets by stabbing knives through his arms. He died on his 14th birthday after jumping off a roof.

*4 I highly recommend Leigh Cowart’s *Hurts So Good*—an exploration of masochists, ultramarathoners, icy ocean bathers, and other people who engage with pain on purpose.

*5 Brain scanners aren’t helpful: It’s unclear what patterns of brain activity would indicate a conscious mind, let alone a conscious mind in pain, let alone a conscious, non-human mind in pain.

*6 Until the 1980s, there were still debates about whether premature or newborn human babies could perceive pain or would benefit from painkillers.

*7 For a sense of the debate, compare reviews written by Sneddon and by a group of authors led by James Rose. You can also read Brian Key’s paper

entitled “Why Fish Do Not Feel Pain,” and the dozens of replies that largely contradict him.

*8 Debates around animal pain can be extremely acrimonious. But notably, Adamo, Sneddon, and Elwood all jointly published a review on defining animal pain, and all speak good-naturedly about each other’s views, even though they disagree.

*9 Crook confirmed this in an experiment. She showed that sea bass will specifically target injured squid, which take evasive maneuvers earlier than uninjured animals. If she treated them with anesthetic, she also slowed their escapes, and reduced their odds of survival.

*10 The answers to these questions could fill a completely different book. Here, I will only note that subjective pain is just one thing to consider when thinking about animal welfare, and may not even be the most important. “ We could simply accept that nociception itself is more than enough to affect an animal’s welfare, and thus may require treatment,” the veterinarian Frederic Chatigny wrote. “Pain, while defined by consciousness, is not necessary for an animal’s wellbeing to be negatively affected.”

5.

So Cool

Heat

I’M COLD. OUTSIDE, THE AUTUMNAL air is a warm 24°C (75°F), but I’m inside what’s essentially a large walk-in fridge that’s been chilled to just 4°C (39°F). It’s an artificial hibernaculum—a room designed to mimic the dark, frigid conditions in which hibernating animals spend the winter. Since I am apparently incapable of packing suitable clothing for a reporting trip, I’ve turned up in a light T-shirt. As heat bleeds from my bare-skinned arms, I instinctively rub them. Meanwhile, Maddy Junkins, who is more sensibly dressed, reaches into a box of shredded paper and pulls out a small furry sphere. It’s a thirteen-lined ground squirrel. Roughly the size and weight of a grapefruit, it’s curled into a ball, with its tail brushing its nose. It looks like a big, fancy chipmunk, with 13 black stripes streaking down its back and light spots within those stripes. I can see those patterns because my eyes can detect the red light that illuminates the room. The squirrel’s eyes cannot, and, regardless, they’re tightly shut. It’s mid-September, and the long hibernation season has begun.

Hibernation isn’t sleep but a more intense state of inactivity that allows the ground squirrel to survive the harsh winters of northern America. During this time, its metabolism almost totally shuts down.[*1] When Junkins delicately places it in my latex-gloved hand, I’m instantly struck by how still it is. There’s none of the manic, twitchy

energy that rodents possess. Its flanks, which ought to be vibrating with frenetic breaths, aren't moving. Its heart, which beats at least 5 times a second in the summer, now ekes out the same number of beats over a minute. "There's usually so much life in your hand, but this is not that at all," Junkins says. "It's an inactive, cold lump." Indeed, the squirrel soon becomes uncomfortably chilly to the touch. Its body has abandoned the summertime norm of 37°C (99°F) and instead hovers at 4°C (39°F), just like every inanimate object in the room. It, too, feels uncannily inanimate—devoid of warmth and so seemingly devoid of life. Only its paws confirm that it's actually living: They're still pink from blood, and, when gripped, they recoil, albeit in slow motion. If I held the squirrel for too long, the warmth of my hand would rouse it, so I put it back in its makeshift den before leaving the hibernaculum. Outside, Elena Gracheva, who runs the facility, is waiting.

"How was it?" she asks.

"So cool," I say.

Gracheva is a scholar of heat and the ways animals detect it. Having studied vampire bats and rattlesnakes (which we'll get to later), she recently turned her attention to the more adorable thirteen-lined ground squirrels and their remarkable ability to withstand low temperatures. "If you put me in a cold room, I'll start to feel pain, and then hypothermia," she tells me. "I probably couldn't survive for more than 24 hours." A thirteen-lined ground squirrel, however, can stay between 2°C (36°F) and 7°C (45°F) for half a year. The closely related Arctic ground squirrel can go even lower, withstanding subzero temperatures of −2.9°C (27°F). These feats of endurance depend on an essential ability that often goes unnoticed: The squirrel *doesn't mind the cold*.

Vanessa Matos-Cruz, who worked with Gracheva, demonstrated this by putting ground squirrels on a pair of heatable plates. If one of these was heated to 30°C (86°F) and the other to 20°C (68°F), where would the animal decide to stand? Rats, mice, and humans almost always go for 30°C since that produces a pleasant sensation of warmth— think about how luxurious heated floors feel. But to thirteen-lined ground squirrels, 20°C is just as delightful as 30°C. They only start gravitating toward the 30°C plate when the alternative falls below 10°C (50°F)—a temperature that rats and mice will completely avoid because it's painfully cold. Even if the second plate falls to 0°C (32°F), the ground squirrels will still stand on it.

Without this tolerance for low temperatures, a ground squirrel wouldn't be able to hibernate. Instead, it would do what we do when we get too cold while asleep: start burning fat to produce heat, and, if that doesn't help, automatically wake up. For us, that's a lifesaver. For a ground squirrel in the dead of winter, it would be lethal. It *needs* to hibernate, and for that to happen, its senses have been adjusted accordingly. It's not that the ground squirrel ignores the cold. Instead, it has a different conception of what "cold" is—a different minimum temperature at which its body can no longer cope and its senses raise an alarm.

All living things are deeply affected by temperature. If conditions are too cold, chemical reactions slow to a useless crawl. If they are too hot, proteins and other molecules of life lose their shape and fall apart. These effects constrain most of life to a Goldilocks zone where the temperature is just right. The limits of that zone vary, but they always exist, which is why every animal with a nervous system has a way of sensing and responding to temperature.

Animals use a variety of temperature sensors, and the most thoroughly studied of these are a group of proteins called TRP channels. They are found throughout the body on the surface of sensory neurons, where they act as tiny gates that open when they reach the right temperature. When this happens, ions enter the neurons, electrical signals travel to the brain, and we feel the sensations of hot or cold. Some TRP channels are tuned to hot temperatures, and others to cold ones. (Cold isn't just the absence of hot; it's a different sense in its own right.)[*2] TRP channels also respond to different severities of temperature: Some detect mild and innocuous ranges, while others fire at dangerous and painful extremes. Certain chemicals can trigger these channels as well, producing heating and cooling sensations. Chili peppers burn because the capsaicin within them triggers TRPV1—a TRP channel that detects painfully high temperatures.[*3] Mint cools because it contains menthol, which activates the cold sensor called TRPM8.

These same sensors are found throughout the animal kingdom, but each species has its own subtly different versions that are calibrated to its body and lifestyle. Warm-blooded animals produce their own heat, and their versions of the cold sensor TRPM8 alert them if their body temperatures start dipping below a narrow comfortable range. In a rat, that set point occurs at around 24°C (75°F). In a chicken, whose body runs at a slightly hotter temperature, TRPM8 is tuned to 29°C (84°F) instead. Cold-blooded animals, by contrast, rely on their environment for warmth, and their body temperatures fluctuate over a wide range. Consequently, their versions of TRPM8 are typically set much lower—at 14°C (57°F) in frogs. Fish seem to lack TRPM8 altogether, and most of them can tolerate temperatures close to freezing. Even if they do feel pain, it

seems that they have no idea what it's like to be agonizingly cold. Individual humans might feel comfortable at different temperatures, but that variation is even greater across the entire animal kingdom.

And what about the ground squirrels? Matos-Cruz found that their version of TRPM8 is very similar to that of other warm-blooded rodents but has a few mutations that make it much less sensitive. It still responds to menthol, but barely reacts to temperatures as low as 10°C (50°F). That partly explains why these squirrels can hibernate so comfortably in conditions we'd find intolerably frigid.[*4]

The TRPV1 sensor, which detects painful heat, is also tuned to the needs of its owners, and especially to their body temperatures. It activates at 45°C (113°F) in chickens, 42°C (108°F) in mice and humans, 38°C (100°F) in frogs, and 33°C (91°F) in zebrafish (which might have no use for a cold sensor but clearly benefit from a hot one). Each species has its own definition of hot. The temperature at which we live would be painful to a zebrafish. The temperature that would start to agonize a mouse wouldn't bother a chicken. And even chickens are overshadowed by two species that have the least sensitive versions of TRPV1 thus far tested, enabling them to shrug off heat that other creatures can't bear. For obvious reasons, one of these is the desert-dwelling Bactrian camel. Unexpectedly, the second is—drumroll, please—the thirteen-lined ground squirrel! The unassuming rodent that I held not only can cope with temperatures that are close to freezing but *also* can abide extreme heat. In Gracheva's hotplate tests, the squirrels will scurry over to a colder plate only if the one they're standing on reaches a scorching 55°C (131°F). No wonder they thrive throughout the United States, from Minnesota in the north to Texas in the south. Their

temperature sensors influence their geographical range, the seasons in which they're active, and much else besides. By defining the temperatures that animals can sense and tolerate, and by tweaking their personal limits of "hot" and "cold," these sensors define where, when, and how they live.

Those lives can be extreme. The Saharan silver ant forages under the midday heat of Earth's greatest desert, over sands that can reach 53°C (127°F), while the Pompeii worm, which lives near volcanic undersea vents, can also resist brief spells at similar temperatures. Snow flies are active at −6°C (21°F), while ice worms spend their entire lives on glacial ice; both animals will die if you hold them. When scientists study these so-called extremophiles, they tend to focus on adaptations like heat-reflecting hairs in their bodies or self-made antifreeze in their blood. But such adaptations would be useless if an animal's sensory system were constantly screaming at it, triggering feelings of pain (or nociception). If you want to live in the Sahara, or at the bottom of the ocean, or on a glacier, you'd better tweak your senses to *like it*.

This concept is intuitive, and yet when we watch extremophiles, from emperor penguins braving the Antarctic chill to camels trekking over scorching sands, it's easy to think that they are suffering throughout their lives. We admire them not just for their physiological resilience but also for their *psychological* fortitude. We project our senses onto theirs and assume that they'd be in discomfort because we'd be in discomfort. But their senses are tuned to the temperatures in which they live. A camel likely isn't distressed by the baking sun, and penguins probably don't mind huddling through an Antarctic storm. Let the storm rage on. The cold doesn't bother them, anyway.

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THE THERMOSTAT IN my house currently reads 21°C (70°F). But the entire house isn't at the same temperature. I'm working in the south-facing living room, which is considerably warmer than the other parts. And as I type these words, my head is being warmed by a sunbeam while my feet are chilling in the shade beneath my desk. Such variations exist at small scales, too: The air 5 millimeters above my skin might be 10°C (18°F) cooler, so a fly that landed on my arm might experience very different temperatures on its legs than on its wings. Being small, the fly would quickly take on the temperature of its environment. If it landed on my head, the sun would heat its body to harmful temperatures within a few seconds. That's unlikely to happen, though, thanks to temperature sensors at the tips of its antennae.

Neuroscientist Marco Gallio demonstrated how good those sensors are by putting fruit flies in chambers whose quadrants were heated to varying degrees—essentially the same experiment that Matos-Cruz did with ground squirrels and hotplates. Gallio showed that flies could easily stay within air spaces that are kept to 25°C (77°F), which they love, while avoiding neighboring zones of 30°C (86°F), which they dislike, or 40°C (104°F), which kills them. They could also make these decisions at incredible speed. Whenever they'd hit the edge of a hot zone, they'd immediately execute a sharp midair U-turn, as if they'd run into an invisible wall.

Such maneuvers are possible because the chitin that makes up a fly's antennae is very good at conducting heat and because the antennae themselves are tiny. They can so quickly equilibrate with their surroundings that a fly can

instantly tell if it has blundered into air that's too hot or cold. Gallio found that it can even use its antennae as stereo thermometers to track gradients of heat, much as a dog uses its paired nostrils for odors. The fly can tell if one antenna is just 0.1°C hotter than the other, and uses those comparisons to steer toward the more comfortable temperature. When Gallio tells me about these results, I suddenly reconsider the movements of every fly I've ever seen. Their paths, which always seemed so random and chaotic, now take on an air of purpose, as if the insect is threading its way through an obstacle course of hot and cold that I can't perceive, don't care about, and oafishly wade through.

The fly's ability is called thermotaxis, and it's common in the animal kingdom.[*5] Creatures big and small use their thermosensors to tell if their surroundings have become intolerable, and to gauge how the temperature around them changes as they move. Like children who are told if they're getting warmer or colder as they approach a hidden object, most animals use changes in ambient temperature to follow the gradients of heat that are created by sunbeams and shadows, breezes and currents. But some have transformed this common ability into something rarer. They can tell if point B is hotter than point A without having to move there. They can actively seek out sources of heat from a distance.

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AT 11:20 A.M. on August 10, 1925, a bolt of lightning struck an oil depot near the town of Coalinga, California. The strike ignited a lake of fire that burned for three days. Flames rose so high that, at night, people could read by

that light from nine miles away. And while they read, they might have also noticed tiny black specks that flew against the billowing curtains of smoke and traveled toward the inferno. These specks were fire-chaser beetles. They were living up to their name.

Moths are famously drawn to flames, but it's the light that attracts them.[*6] The fire-chasing *Melanophila* beetles, however, are drawn to heat. These black, half-inch-long insects have been found in what entomologist Earle Gorton Linsley described as "unbelievable numbers" in smelting plants, the kilns of cement factories, and the vats of hot syrup in sugar refineries. One summer, Linsley saw them swarming an outdoor barbecue where "large quantities of deer meat were being prepared." In the 1940s, the insects would regularly bother football fans in Berkeley's California Memorial Stadium "by alighting on the clothing or even biting the neck or hands," Linsley wrote. It's possible that "the beetles are attracted by the smoke from some twenty thousand (more or less) cigarettes which on still days sometimes hangs like a haze over the stadium." These incidents are unfortunate for both species, because industrial plants, barbecues, and football stadiums are unhelpful distractions that waylay the beetles from their true targets: forest fires.

Arriving at a fire, the beetles have perhaps the most dramatic sex in the animal kingdom, mating as a forest burns around them. Later, the females lay their eggs on charred, cooled bark. When the wood-eating grubs hatch, they find an Eden. The trees they devour are too injured to defend against insect larvae feeding within them. The predators that might eat them are put off by the smoke and heat emitted from the embers and ashes. In peace, they thrive, mature, and eventually fly off in search of their own

blazes. But forest fires are rare and unpredictable, and the beetles must have some means of detecting them from afar. Being active during the day, the beetles can't spot distant flames in the way that nocturnal insects easily could. They can't rely on seeing plumes of smoke since their eyes probably aren't sharp enough to distinguish such plumes from clouds. And though their antennae can certainly detect the smell of scorched wood, such clues are heavily influenced by the direction of the wind. For them, the most reliable cue is heat.

The atoms and molecules in all objects are constantly jiggling about, and this motion produces electromagnetic radiation. As an object gets hotter, its molecules move faster, and it emits more radiation at higher frequencies. That radiation includes some visible light—think about the glow of heated metal—but most of it lies in the infrared spectrum.[*7] We can't see infrared, but we might be able to feel it. When you stand near a fireplace, infrared light radiates from the burning wood. When it reaches you, its energy is absorbed and heats up the closest parts of your skin, triggering the temperature sensors within it. You feel the heat. You can also work out where it's coming from because the parts of your body under infrared illumination are getting hotter while those that lie in the infrared shadow are not. But this trick only works at close range. Infrared light spreads from the fireplace in all directions, and some of it gets absorbed on its travels. As you walk farther from the logs, less and less of that light reaches you, until its imparted energy no longer warms your body to a noticeable degree. To detect the infrared light from a distant source, either the source must be extremely intense (like the sun) or you need specialized equipment. *Melanophila* beetles have the latter.

Below their wings and just behind their middle legs, these insects have a pair of pits. Each one contains a cluster of around 70 spheres that together look like a malformed raspberry. When zoologist Helmut Schmitz examined these spheres under a microscope, he saw that each is filled with fluid and encloses the tip of a pressure-sensitive neuron. When infrared radiation hits the spheres, the fluid inside them heats up and expands. It can't bulge outward because the spheres have hard exteriors, so instead it squeezes the nerves, causing them to fire. This is a different kind of heat sensing than what we've seen earlier in this chapter. Unlike hibernating ground squirrels or zipping fruit flies, the beetles aren't just measuring the ambient temperature of their surroundings. Instead, much as we do when we bask by a fireplace, they're sensing radiant heat that travels from hot sources in the form of infrared light.

The beetles' spherical sensors must be extraordinarily sensitive, since the insects frequently travel to burning forests and other hot places from dozens of miles away. The Coalinga oil depot that was struck by lightning in 1925 lies in the middle of an arid, treeless region, and most of the beetles that arrived there likely came from forests that lay 80 miles to the east. Based on this distance, and simulations of the 1925 blaze, Schmitz calculated that the beetles' pits are more sensitive than most commercial infrared detectors and on a par with state-of-the-art quantum detectors that must first be cooled with liquid nitrogen. Schmitz thinks that the pits couldn't possibly be this sensitive on their own. The beetles must have ways of making them more responsive.

During flight, their beating wings create vibrations that travel into the nearby pits, shake the spherical sensors, and

push the sensory neurons within to the edge of firing. It now takes much less infrared radiation to fully push them over that edge. Think of this another way: Imagine a brick that's lying flat on its side. If a fly crashed into it, it wouldn't budge. But if it was instead balanced on its edge, even a fly would be enough to topple it. In that state, the brick would be primed to react to a tiny amount of energy. Schmitz argues that a fire-chaser beetle's beating wings prime its heat sensors in a similar way, setting them up to detect sources of infrared that would normally be too weak. A beetle that's sitting on a tree would be relatively insensitive. But as soon as it takes off in search of fires, its body automatically widens its search area and transforms even faint traces of distant heat into blazing beacons.[*8]

The beetles' bodies are relevant in another way. As with all insects, their outer surface is very good at absorbing the kinds of infrared radiation that fires emit. The beetles were effectively pre-adapted for chasing fires. Their ancestors merely needed to develop a sensor that could make sense of the infrared light that their bodies naturally absorb. The 11 species of *Melanophila* did this and became so successful that they spread across five continents. They never reached Australia, though. There, three other types of insects independently evolved infrared sensors that allow them to exploit the tranquil paradise of a charred forest. Fire-chasing is a trick so useful that it has evolved at least four times over. And fires are not the only sources of heat that an animal might want to track. Some species search for the warmth of bodies.

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"YOU'RE DEFINITELY NOT allowed to come in here," Astra Bryant tells me. I dutifully oblige, hovering outside while Bryant rummages through a fridge. After a few minutes, she emerges with a pipette that holds 5 microliters of clear liquid in its tip. It's a volume so small I can barely see it. I certainly can't see the thousands of nematode worms that are swimming inside.

Nematodes are one of the most diverse and numerous groups of animals, including tens of thousands of species that are mostly harmless to humans. The exceptions include the species that Bryant is carrying—*Strongyloides stercoralis,* the threadworm. Its larvae abound in soil and water that are contaminated by feces. If an unlucky person stands or walks through such places, the worms swim toward them and penetrate their skin. Threadworms, along with hookworms and other skin-penetrating nematodes, infect around 800 million people around the world, from Vietnam to Alabama. They cause gastrointestinal problems, stunted development, and sometimes death. They're also very hard to treat. Bryant and her mentor Elissa Hallem are trying to find out how the worms find their hosts in the first place, in order to create new ways of preventing infections. Odors are certainly part of the equation. So is heat.

Bryant carries her pipette of monstrosities to a steel chamber with a biohazard sign on its door. Inside, there's a slab of translucent gel that has been asymmetrically heated so its right side is at room temperature, while its left is the temperature of a human body. Bryant squeezes the worms out onto the middle of the slab, and they appear on a nearby monitor as a ring of white dots. With horrific immediacy, the dots start to move. The ring quickly stretches into a cloud that drifts leftward toward the heat. Drifts? More like zooms. Each worm is just a millimeter or

two long, but quickly covers a distance several hundred times greater. I'm starting to understand why hundreds of millions of people are infected. Within three minutes, they're all huddled on the leftmost edge, searching for the source of the heat they can sense but not find. "This was *shocking* the first time I saw it," says Bryant, who expected the worms to spend hours traveling distances that in fact they covered in minutes. "I show this in my talks, and I generally get groans out of the audience."

Parasitism may be grisly, but it's one of the most common lifestyles in nature. It's likely that the majority of animal species are parasites, which survive by exploiting the bodies of other creatures. Many of these freeloaders are fastidious about their choice of hosts and need some way of finding the right targets. Smells provide good cues. But hundreds of millions of years ago, another possibility emerged.

The ancestors of birds and mammals independently evolved the ability to produce and control their own body heat, divorcing their temperatures from the temperatures of their surroundings. This ability, known technically as endothermy and colloquially as warm-bloodedness, endowed birds and mammals with speed and stamina, durability and possibility. It allowed them to survive in extreme environments and stay active over long durations and distances. It also made them very easy to track. Their unwavering body heat made them perpetually blaring beacons, which parasites could use to find hosts, and especially blood vessels. Blood, after all, is a superb source of food—rich in nutrients, well balanced, and usually sterile. It's no surprise that at least 14,000 animal species have evolved to feed on it, or that many of these—bedbugs,

mosquitoes, tsetse flies, and assassin bugs—are attuned to heat.

Among mammals, only three species of vampire bats feed exclusively on blood. Two mostly drink from birds, but the common vampire targets mammals, especially large ones like cows or pigs. It's a small animal that measures 3 inches from nose to tail and has a flattened, pug-like face. On the ground, its wings fold back, and it adopts a sprawling, four-legged stance. It approaches targets like this, either landing directly on their backs or alighting nearby and crawling over in a most un-bat-like way. Once near, it painlessly inflicts a small cut with its blade-like incisors and laps up the blood that flows out. A compound in its saliva, aptly known as draculin, stops the blood from clotting, allowing the bat to feed for up to an hour. It can drink its own body weight in blood and must do so once a night to survive. Other senses help it to track a target from afar, but once it gets at least 6 inches away, it uses a thermal sense to pick a good bite site.

The vampire's heat sensors lie in its nose, which consists of a heart-shaped flap lying over a semicircular pad. Sandwiched between these layers are a trio of millimeter-wide pits, each one riddled with heat-sensing neurons. Among infrared-sensing animals, vampire bats have a unique problem because they are themselves warm-blooded. The neurons in their pits ought to be bamboozled by their own body heat, but a dense network of tissue insulates them and keeps them 9°C (16°F) cooler than the rest of the bat's face.

Elena Gracheva studied those neurons in the days before she started working with those adorable ground squirrels. Her colleagues in Venezuela rode to caves where the bats roost, lured them out using their own horses as bait,

dissected out their pit neurons, and shipped the tissue samples to Gracheva in the United States. By analyzing those samples, she showed that the neurons are loaded with a special version of TRPV1—the same temperature sensor that we met earlier in this chapter, which usually detects painful heat and the sting of chilies. TRPV1 is calibrated to different temperatures depending on what respective animals would find painfully hot—33°C (91°F) in a cold-blooded zebrafish, and 42°C (108°F) in a warm-blooded mouse or human. In the vampire bat, TRPV1 is set at a typical mammalian level, except in the pit neurons, where it instead goes off at a much lower temperature, 31°C (88°F). The bat has retuned this sensor from one that detects extreme heat into one that detects body heat.

Ticks also suck blood, but their heat sensors are found on the tips of their first pair of legs. When they wave these legs around—a behavior known as questing—it looks like they're waiting to grab something. They are, but they're also sensing. Jakob von Uexküll, coiner of the Umwelt concept, wrote that ticks track their hosts through scent and use temperature only to check if they've landed on bare skin. But this isn't true. Ann Carr and Vincent Salgado recently found that ticks can detect body heat from up to 13 feet away. More surprisingly, the duo showed that common repellents like DEET and citronella don't disrupt a tick's sense of smell but *do* stop them from tracking heat. This discovery might lead to new ways of preventing tick bites, and it might force scientists to reevaluate a lot of previous tick studies. How many past experiments have been misinterpreted because researchers have had an inaccurate picture of a tick's Umwelt?

In hindsight, the tick's thermal sense should have been clear. The organs at the tips of their questing legs were

mostly thought to be odor detectors. But these structures also include tiny spherical pits with neurons at their bases, much like those on a vampire bat's face. Tellingly, these pits are covered with a thin sheet that has a small hole in it. That's a terrible design for a nose, because the sheet would block most odorants from reaching the underlying neurons. It is, however, an excellent design for an *infrared* sensor. Infrared radiation, emanating from the blood of a distant host, would be mostly blocked by the sheet, but some would pass through the hole to partly illuminate the pit below. By analyzing which bits were lit up, the tick could work out the direction of the radiation, and the whereabouts of its source. This idea still needs to be confirmed, but it makes sense. After all, it's how the most sophisticated heat sensors in nature work. To find them, you need a little courage, some shin guards, and a long pole.

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WE CAN'T FIND Julia. We know she's right in front of us, lurking within a rat nest that's inside a prickly pear bush, but we can't see her. We can hear a loud telltale beep as our antenna picks up a radio signal from the transmitter inside her, but she herself is silent. She's not even rattling. We leave her be and head off in search of another snake.

My wife, Liz Neeley, and I have come looking for rattlesnakes in a fenced tract of California scrubland that's owned by the U.S. Marine Corps. Leading us are Rulon Clark—who spent his childhood running around after snakes and lizards and never really stopped—and his student Nate Redetzke. Redetzke regularly has to relocate snakes that show up in nearby homes and has implanted

several of them with radio trackers. Having parked on a dirt lane aptly called Rattlesnake Canyon Road, we donned Kevlar shin guards and tromped off through the sagebrush, breathing in the fennel-scented air, dodging poison oak, and clambering over boulders.

“Working with reptiles makes you very sensitive to temperature and weather,” says Clark. He started our expedition in the early morning, hoping to find rattlesnakes that were openly basking in what forecasts said would be an unseasonably warm October day. But the forecasts were wrong. It’s actually cold and overcast, so although we are out, the snakes are not. Powers was hidden deep within a cactus. Truman was somewhere inside a pile of boulders. Julia was out of sight. (Redetzke has named them all after former presidents and first ladies.) We’re about to give up when he hears a loud beep, perks up, and bounds off around the hillside. Moments later, he shouts that he’s found Margaret. He prizes apart the branches of a bush, reaches in with a pair of tongs, and pulls out a red diamond rattlesnake—rust-colored and 3 feet long. Red diamonds are supposedly docile, but even they have their limits. As Redetzke lowers Margaret into a bag, she strikes it, leaving globs of yellow venom on the cloth. Once inside, she rattles, but she’s cold and the sound is dull.

Later, Redetzke nudges Margaret into a plastic tube that’s just wider than her body. Gently gripping her tail at one end, I stare down the other into her face. The pupils are vertical slits. The mouth curves upward in what looks like a grimace. The lidless eyes are overhung by large horizontal scales that create what I call resting viper face—a look of perpetual anger. It’s a visage that normally instills fear. But I find her beautiful. Who knows what she makes of me, but at this distance, she can certainly see me, and not

just with her eyes. With a pair of small pits nestled just behind her nostrils, she can detect the infrared radiation that's flooding from my warm face and, to a lesser extent, from my clothed body. Against the cool morning sky, I must be shining.

Heat-sensitive pits have evolved independently among three groups of snakes. Two of these, pythons and boas, are non-venomous constrictors that kill with suffocating coils.[*9] The third are the highly venomous and aptly named pit vipers—cottonmouths, copperheads, moccasins, and rattlesnakes.[*10] Rattlesnakes will strike at warm objects, preferring freshly killed mice over long-deceased ones, and they'll hit their targets in complete darkness. Even a congenitally blind rattlesnake that was born without eyes could kill mice as effectively as a sighted individual. Thanks to its pits, its aim was good enough not only to hit the rodents but to specifically strike them in the head.

A pit viper's thermal sensitivity comes from the structure of its pits (which are similar to those on a tick's legs). To get an idea of their shape, imagine placing a miniature trampoline on the bottom of a goldfish bowl and turning the whole thing on its side. There's a narrow opening, leading into a wider air-filled chamber, across which a thin membrane is stretched. When infrared radiation passes through the opening, it falls upon the membrane and heats it up. This happens readily because the membrane is exposed to the elements, is suspended in midair, and is a sixth as thick as a page of this book. It is also riddled with some 7,000 nerve endings that detect the slightest rise in temperature. Those nerves, as Elena Gracheva discovered, are packed with the heat sensor TRPA1, carrying 400 times as much of it as neurons elsewhere in the snake's body. They'll respond if the

membrane rises in temperature by as little as 0.001°C. This astonishing sensitivity means that a pit viper can detect the warmth of a rodent from up to a meter away. A blindfolded rattlesnake that's sitting on your head could sense the warmth of a mouse on the tip of your outstretched finger. [*11]

The pits are structurally similar to eyes. The membrane, which detects infrared light, is like a retina. The opening, which allows that light to enter, is like a pupil. And just like a pupil, the opening is narrow, which means that some regions of the membrane are heated by incoming infrared while others lie in cool shadow. The snake can use these patterns of hot and cold to map a heat source in its vicinity just as it uses the light falling on its retina to construct an image of a scene. These similarities aren't just metaphorical. Some scientists think that the pits really are a second pair of eyes, tuned to the infrared wavelengths of light that are invisible to the main pair. Signals from the two organs are initially processed by different parts of the brain but eventually feed into a single region called the optic tectum. There, the two streams are combined, and information inputs from the visible and infrared spectrums are seemingly fused together by neurons that respond to both. It's possible that the snakes really are *seeing* infrared, treating it as just another color. " It is a fallacy to consider the pit organs as an independent sixth sense," neuroscientist Richard Goris once wrote. "What the pits do is improve vision for their owners." They might provide more detail at night, reveal warm objects that are obscured by undergrowth, or direct the snake's attention to scurrying prey.[*12]

But if the pits are eyes, they're very simple ones with blurry vision. They only have thousands of sensors

compared to the millions in a typical retina, and they have no lens to focus the incoming infrared. Nature documentaries get this wrong when they try to show what rattlesnakes see by filming the world with thermal cameras. Those images, with white and red rodents moseying in front of blue and violet backgrounds, are always unrealistically detailed. *Predator,* the 1987 movie in which Arnold Schwarzenegger encounters a trophy-hunting alien, did a better job of depicting the blurriness of infrared vision. (This is perhaps the only time that anyone has accused *Predator* of being realistic.)

Recently, physicist George Bakken simulated what the pits would pick up when a mouse runs across a log. He got grainy images of small warm blobs moving over large cool blobs. A mouse on your finger might be detectable to a blindfolded rattlesnake on your head, but it would be shapeless unless it ran onto your biceps. Pit vipers compensate for this shortcoming by carefully choosing their ambush sites. Sidewinders tend to point toward thermal edges where the environment rapidly flips between hot and cold and a moving warm-blooded animal might be easier to spot. And on China's Shedao Island, the local pit vipers choose ambush sites that face into open sky, allowing them to more easily detect the migrating birds they gorge upon in spring.

How do the snakes actually perceive heat? Chinese herpetologist Yezhong Tang found a hint by working with short-tailed pit vipers. If he blocked one eye and one pit on the same side, the snakes bit their victims 86 percent of the time. If he blocked either both eyes or both pits, their accuracy fell slightly to 75 percent. But if he blocked one eye and one pit *on opposite sides,* they landed just 50 percent of their strikes. That unexpected result suggests

that the snakes are combining visual and infrared information. But how do they manage when those senses operate at such different resolutions? Bakken wonders if the brain could learn to better interpret the coarse information it gets from the pits using the much sharper information from their eyes. After all, humans can program artificial intelligences to classify pictures or spot hidden patterns by training them on a large enough set of images. Maybe a snake's eyes provide the training set that its brain needs to interpret the blurry information from the pits.

Whatever advantage the pits provide, it must be significant. The nerves in their membranes are loaded with tiny batteries called mitochondria, far more than exist in typical sense organs. This suggests that the infrared sense demands a lot of energy, so it must provide benefits that are worthy of that cost. It certainly seems to give pit vipers an edge over pit-less snakes.[*13] But the more I ask Clark about the infrared sense, the more unanswered questions I'm left with.[*14] Why did pit vipers evolve it when most of them also have excellent night vision? If the infrared sense bolsters vision, then why didn't it also evolve in other nocturnal vipers? Why did pythons and boas, which are separated from vipers by some 90 million years of evolution and hunt in very different ways, evolve the same trick when more closely related snakes, like cobras and garter snakes, did not? And most puzzlingly, why do the pits seem to work better when they're cold?[*15] "There's something that we're missing," Clark tells me. "Maybe the infrared sense is simply about targeting prey, but I think they're using it in ways that we don't understand."

To understand another animal's Umwelt, you have to watch its behavior. But a pit viper's behavior mostly consists of waiting. Since they don't generate their own

body heat, they can go without eating for months and can sit in ambush until exactly the right moment. The few researchers brave enough to study them end up with animals that mostly sit around doing nothing, which makes them very hard to train—or comprehend. After all, even animals that we already understand and that we know how to train can sense heat in ways that are hard to explain.

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WHEN ZOOLOGIST RONALD Kröger got a dog—a golden retriever named Kevin—he started wondering about its nose. Sleeping dogs tend to have warm noses. But shortly after they wake up, the tips become wet and cool. Kröger found that in a warm room, a dog will keep its nose around 5°C cooler than the ambient temperature, and between 9° and 17°C colder than the nose of a cow or pig in the same space. Why? Vampire bats and rattlesnakes both seem to cool their heat-sensitive pits. Could dogs be doing the same? Could their noses be infrared sensors as well as organs of smell?

Kröger certainly thinks so. His team successfully trained three dogs—Kevin, Delfi, and Charlie—to tell the difference between two panels that looked and smelled the same but that differed in temperature by 11°C. In double-blind tests, when handlers didn’t know the right answer and couldn’t unconsciously influence the dogs, the three canines still picked the right panel between 68 and 80 percent of the time. The team suggests that wolves, the ancestors of domestic dogs, might have benefited from detecting the infrared radiation coming off their large prey. But since such radiation rapidly weakens with distance, how would it benefit animals that already have acute senses of hearing

and smell? Surely a wolf would be able to sniff its meals well before its nose could detect telltale hints of warmth. And at close quarters, surely its eyes and ears would help it track a running target without any help from an infrared-sensing snout. “It’s hard to imagine how this could be actually useful,” says Anna Bálint, who worked on the study. “I guess we have to think outside of the box.”

When thinking about another Umwelt, distance always matters. Under the right conditions, smell and vision operate over vast scales. Infrared senses work over shorter distances, unless they’re honed to detect a blazing forest fire. And some senses are more intimate still, requiring the closeness of contact.

Skip Notes

*1 The two processes are so different that hibernating ground squirrels actually incur sleep debt and must periodically rouse from inactivity and raise their body temperatures so they can get some actual sleep.

*2 In the 1880s, Magnus Blix used a pointed metal tube, connected to bottles of water at varying temperatures, to show that certain spots on his hand were sensitive to hot and others to cold. Two other scientists, Alfred Goldscheider and Henry Donaldson, independently made the same discovery at the same time.

*3 Contrary to popular belief, this isn’t a matter of taste. As I can attest, having once taken a shower immediately after chopping habanero peppers, if you get enough capsaicin on your hands and other delicate body parts, you’ll experience that burning sensation everywhere you touch.

*4 There’s a version of the human TRPM8 that becomes increasingly common at higher latitudes and might reflect an adaptation to colder climates. It’s still unclear whether people who carry this version perceive cold in a different way.

*5 Fish, from tiny larvae to 30-foot whale sharks, will control their temperatures by ascending to warmer shallows or diving to colder depths. Sulfide worms that live in hydrothermal vents, where scalding volcanic fluids bubble out of the seafloor, can find pockets of cooler water amid the roiling plumes. Butterflies that are warming their flight muscles in a sunbeam will stop basking when temperature sensors in their wings tell them that they're overheating. Turtle embryos can even pull off thermotaxis within the confines of their eggs, shuffling over to bask on the warmest side before they've even hatched.

*6 Naomi Pierce, who showed that butterflies have temperature sensors in their wings, isn't fully convinced that moths are only drawn to the light of candle flames. She and her colleague Nanfang Yu have spent years investigating the possibility that moth antennae can act as infrared detectors.

*7 Infrared light covers such a huge range of wavelengths that if you represent it by the length of your arm, the visible spectrum would be no wider than a hair. The shortest of these wavelengths, also known as near-infrared, can be seen by certain animals like the migrating salmon we met in Chapter 1 or humans wearing night-vision goggles. Mid-wavelength infrared lies beyond the scope of such sensors; these are the wavelengths that heat-seeking missiles seek, that forest fires emit, and that fire-chaser beetles chase. Far-infrared is what warm bodies give off. It's what thermal imaging cameras and rattlesnakes detect.

*8 For now, this idea is speculative, and very hard to test. Schmitz would have to take electrical recordings from a beetle's neurons, and do so in a way that doesn't leach any heat from the pits. And if his theory about the flapping wings is right, he'd have to do this in a flying insect. "That's very hard," he says, with Germanic understatement.

*9 In some ways, the pit organs of boas and pythons are very different from those of pit vipers. Their membranes aren't suspended, and are likely less sensitive. They have several pairs of pits running up the sides of their heads, instead of a single pair at the front of their heads—a pattern that George Bakken compares to the compound eyes of insects. And yet, Elena Gracheva found that all three groups rely on the same heat sensor—TRPA1.

*10 The first Western scientist to describe their pits, back in 1683, correctly guessed that they were sense organs, but wrongly supposed that they were ears. Just as wrongly, others suggested that they were nostrils, tear ducts, or sensors of smells, sounds, or vibrations. No one hit on the right answer until 1935, when Margarete Ros—no relation to Margaret the snake—noticed that

she could stop her pet python from slithering toward warm objects by covering its pits with Vaseline. She deduced that the snake uses its pits to sense the body heat of its prey.

*11 Just trust me on this one and don't try it at home.

*12 Some researchers have claimed that ground squirrels can fool a rattlesnake's infrared sense. When confronted, they raise their tails and heat them up by pumping warm blood into them. This would increase the size of their thermal silhouette and make them seem more intimidating to a heat-sensing predator. Tellingly, the squirrels only do this to rattlesnakes, and not to harmless gopher snakes that can't sense infrared. This has been billed as the first known example of infrared communication between two species. But Clark and others aren't convinced. The squirrels might just be raising their tails and pumping blood into them because they're alarmed. And they might be doing this to rattlesnakes instead of gopher snakes because the former are more alarming!

*13 Ecologist Burt Kotler, based in Israel, demonstrated this by setting pitted sidewinder rattlesnakes against horned vipers from the Middle East—very similar to the rattlers except that they lack an infrared sense. When Kotler placed both snakes in large outdoor enclosures, the pit-less horned vipers became less active on moonless nights, ceding the darkness to the sidewinders, which could still use heat to hunt. The Israeli rodents in those enclosures also came to treat the alien sidewinders as a threat greater than their own native vipers. Kotler describes the pits as a "constraint-breaking adaptation"—an innovation that shunts snakes to the next level of predatory effectiveness by allowing them to hunt in even the dimmest light.

*14 One of Clark's students, Hannes Schraft, found several confusing results when he tried to study pit vipers in the wild. At night, sidewinders lie in wait in bushes, which are slightly warmer than the surrounding sands and should act like glowing landmarks. But Schraft found that blindfolded sidewinders are appalling at finding bushes, and will wander erratically without success. He also wondered if the snakes use their infrared vision to gauge the temperature of their prey, since colder targets should be slower and easier to catch. They don't. Schraft presented them with lizard carcasses that had been warmed with a hot water bottle, and the snakes didn't care.

*15 In 2013, Viviana Cadena found that rattlesnakes can control the way they exhale to actively cool their pits, keeping them a few degrees below their body temperatures. A few years later, Clark and Bakken kept rattlesnakes at various temperatures and measured their ability to spot a warm pendulum moving

over a cooler background. To their surprise, the colder the snakes, the better they were at tracking the pendulum. “We were gobsmacked,” says Bakken. This pattern doesn’t make sense if the main heat sensor is TRPA1, which ought to work better at higher temperatures. It doesn’t make sense since cold-blooded animals should be more effective as they get warmer. As a rattlesnake heats up, it becomes a faster and more active hunter…just as one of its main hunting senses becomes less sensitive? “It’s backward and I don’t know what to make of it yet,” says Clark. In a refreshing act of academic straight talk, he and Bakken published their results under the title “Cooler Snakes Respond More Strongly to Infrared Stimuli, but We Have No Idea Why.”

6.

A Rough Sense

Contact and Flow

AT FIRST, EVERYONE THOUGHT THAT Selka was sleeping. An adolescent sea otter, Selka was living in an enclosure at the Long Marine Laboratory in Santa Cruz, with a pool that had a fiberglass table resting just above the water's surface. She had taken to swimming under the table, sticking her nose into the narrow air space just below it, and having a nap—or so it seemed. It turned out that between snoozes, Selka had also been slowly unscrewing the nuts that held the table legs in place. One day, Sarah Strobel, a sensory biologist who had been working with the otter, found the entire platform tilting on its side. Selka was swimming around cradling a dislodged table leg, having stuffed the accompanying nuts and bolts down the drain.

Almost every photograph of sea otters shows them floating on their backs, often asleep, sometimes holding hands. This creates the deeply misleading impression that they are lazy and sedate. In fact, "they're really fidgety," Strobel tells me. "They're constantly doing things, playing with things, wanting to touch things." This rambunctious quality is something that sea otters share with other mustelids—the mammal group that includes weasels, ferrets, badgers, honey badgers, and wolverines. But sea otters combine what Strobel calls a "general mustelid mojo" with large size—at 3 to 5 feet in length, they're the biggest of the group—and unusually dexterous paws. Consequently, they're infamously hard to house in captivity.

[*1] “They’re just super-destructive,” says Strobel. “They’re very curious, and the way they manifest that curiosity is: *How can I break this and figure out what’s inside?*”

Inquisitiveness, dexterity, and a penchant for disassembly: These traits serve sea otters well in their native habitat along the western coast of North America. Those frequently cold waters challenge a creature that, though large for a mustelid, is unusually small for a marine mammal. Sea otters have neither the large heat-retaining bodies nor the insulating blubber of seals, whales, and manatees. They do have the densest fur in the animal kingdom, with more hairs per square centimeter than humans have on our heads, but even that isn’t enough to stop heat from rapidly bleeding off their bodies. To stay warm, they need to eat a quarter of their own weight every day; hence their frenetic nature. They’re always diving, day and night. Almost everything’s on the menu, and almost everything is grabbed by hand. Even when there’s not enough light to see by, their paws lead them to food. With the same manual dexterity that Selka displayed in dismantling her table, wild sea otters snag fish, seize sea urchins, and dig out buried clams. Their delicate sense of touch allows them to survive as a small, warm mammal in a big, cold ocean.

The sensitivity of their paws is evident in their brains. As in other species, a region called the somatosensory cortex deals with touch. Different sections of the somatosensory cortex receive inputs from different parts of the body, and the relative size of these sections can hint at an animal’s major tactile organs. In humans, the hands, lips, and genitals are most heavily represented. In mice, it’s the whiskers; in platypuses, the bill; and in naked mole-rats, the teeth. In sea otters, the part of the somatosensory

cortex that receives signals from the paws is disproportionately big compared to those of other mustelids, and even compared to those of other otters.

Those paws don't look like sensitive hands, though. They barely look like hands at all. The skin has the texture of a cauliflower head, and the digits aren't clearly separated. If you held the paw, you could feel the nimble fingers moving underneath, but if you just looked at it, you'd see "knobbly mittens," Strobel tells me. To measure what these mittens are capable of, she put Selka to a test. She trained the otter to recognize the feel of a textured plastic board that was covered in thinly spaced ridges. Selka then had to distinguish that board from others whose ridges were either slightly narrower or slightly further apart. And she did so, reliably and repeatedly, even when the ridges differed in their spacing by a quarter of a millimeter. Her paws really are as sensitive as her brain would suggest.

Sensitivity, however, is not the only metric by which a sense can be judged. As we saw in Chapter 1, humans and dogs can both follow chocolate-scented strings, but the former species labors slowly at the task while the latter does it quickly and assuredly. Likewise, Strobel found that humans are just as sensitive as sea otters at discriminating textures with their hands, but the latter are substantially faster.[*2] In her experiment, human volunteers repeatedly ran their fingertips over the two possible boards, again and again, until they finally made their choice. Selka picked the right board as soon as she laid her paw on it. If the first one she touched was correct, she didn't even bother feeling the alternative. She made her choice in a fifth of a second, 30 times faster than her human rivals. Even her slowest decision times were considerably faster than those of the

fastest humans. “They’re very confident in whatever they’re doing,” says Strobel.

Imagine that, right now, a sea otter is about to search for food. Floating on its back on the surface of the sea, it rolls and dives. It will only stay submerged for a minute—roughly the time it will take you to read this paragraph. The descent eats up many of the precious seconds, so once the otter reaches the right depth, it has no time for indecisiveness. In a few frantic moments, it presses its knobby mittens over the seafloor, inspecting whatever it can find. The water is dark, but darkness doesn’t matter. To some of the most sensitive paws in the world, the ocean is bright with shapes and textures to be felt, grasped, pressed, prodded, squeezed, stroked, and manhandled—or perhaps otterhandled. Hard-shelled prey nestle among the similar hard rocks, but in a split second, the otter feels the difference between the two, and pulls the former from the latter. With its sense of touch, its dexterous paws, and its overabundant mustelid confidence, it snatches that clam, yanks that abalone, grabs that sea urchin, and finally ascends to eat its catches, breaking the water at the end of this sentence.

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TOUCH IS ONE of the mechanical senses, which deal with physical stimuli like vibrations, currents, textures, and pressures. For many animals, touch can operate at a distance. As we shall see later in this chapter, creatures as diverse as fish, spiders, and manatees can all feel the hidden signals that flow, blow, and ripple through air and water. Using tiny hairs and other sensors, they can feel the telltale signals of other animals from afar. Crocodiles can

detect the gentlest ripples at the water's surface, crickets can sense the faint breeze produced by a charging spider, and seals can track fish by the invisible currents that they leave as they swim. But most such signals are undetectable to us: I can feel the strong air currents created by my ceiling fan, but little else. For humans (and sea otters), touch is primarily a sense of direct contact.

Our own fingertips are among nature's most sensitive touch organs. They allow us to wield tools with fine precision, to read patterns of raised dots when our vision is impaired, and to control screens with taps, swipes, and touches. Their sensitivity depends on mechanoreceptors—cells that respond to light tactile stimulation. These cells come in several varieties, each of which responds to a different kind of stimulus. Merkel nerve endings respond to continuous pressure: They help you gauge the shape and material properties of this book as you squeeze its pages. Ruffini endings respond to tension and stretch in the skin: They help you adjust your grip, and recognize when objects slip from your grasp. Meissner corpuscles respond to slow vibrations: They produce the feelings of slip and flutter as your fingers move over surfaces, and they allow Braille readers to make sense of raised dots. Pacinian corpuscles respond to faster vibrations: They're useful in assessing finer textures or in sensing objects through tools, like hairs that are gripped by tweezers or soil that crunches beneath a spade. Most of these receptors also exist in a sea otter's paw or a platypus's snout. Collectively, they produce the sensation of touch, just as our sweet, sour, bitter, salt, and umami receptors together define our sense of taste.

At a broad level, we understand how these mechanoreceptors work. Despite their variety, they all consist of a nerve ending enclosed in some kind of touch-

sensitive capsule. A tactile stimulus bends or deforms the capsule, causing the nerve inside to fire. But exactly how this happens is still unclear, because touch is one of our least-studied senses. Compared to sight, hearing, or even smell, it inspires less art and fewer scientific devotees. Until very recently, the molecules that allow us to experience touch—the equivalent of opsins for vision, or odorant receptors for smell—remained completely mysterious. We only have a rough sense of the sense that senses roughness.

But touch cannot be ignored. It is a sense of intimacy and immediacy—and it varies just as much as smell or vision. Animals differ widely in how sensitive their touch organs are, what they use those organs to feel, and even the body parts on which those organs are found. And by considering how touch contributes to the Umwelten of different creatures, we will see sandy beaches, underground tunnels, and even internal organs in new ways. Even the true extent of our *own* tactile abilities has only recently come to light. In one experiment, people could distinguish between two silicon wafers that differed only in their topmost layer of molecules, telling them apart thanks to minuscule differences in the way their fingers slid over the two surfaces. In another test, volunteers could tell the difference between two ridged surfaces, even when those ridges differed in height by just *10 nanometers*—akin to judging which of two sandpapers is coarser, when the grains are only the size of large molecules.

These incredible feats are possible through movement. If you rest a fingertip upon a surface, you can get only a limited idea of its features. But as soon as you’re allowed to move, everything changes. Hardness becomes apparent with a press. Textures resolve at a stroke. As your fingers

run over the surface, they repeatedly collide with invisibly small peaks and troughs, setting up vibrations in the mechanoreceptors at their tips. That's how you detect the subtlest of features, even down into the nanoscale.[*3] Movement transforms touch from a coarse sense into an exquisite one. It allows many of nature's tactile specialists to react with incredible speed.

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MANY SCIENTISTS SPEND their entire lives studying the same animals. Ken Catania is an exception. In the last 30 years, he has investigated the senses of electric eels, naked mole-rats, crocodiles, tentacled snakes, emerald cockroach wasps, and humans. He is drawn to oddities, and his attraction to weird creatures almost always pays off. "Usually, it's not that, oh, the animal turned out not to be interesting," he tells me. "Usually, it's that the animal is ten times more capable than I could have imagined." No creature taught him that lesson more acutely than the first one he studied: the star-nosed mole.

The star-nosed mole is a hamster-sized animal with silky fur, a rat-like tail, and shovel-like paws. It lives throughout the densely populated eastern parts of North America, but since it dwells in bogs and swamps and spends most of its time underground, few people ever see it. Those who do would recognize it instantly. On the tip of its snout, it has 11 pairs of pink, hairless, finger-like appendages, arranged in a ring around its nostrils. This is the unmistakable star for which the mole is named. It looks like a fleshy flower growing out of the animal's face, or perhaps a sea anemone impaled on its nose.

Scientists have long speculated about what the star might be for, but the answer was obvious to Catania when he first examined it under a microscope in the 1990s. He expected to see a world of different sensors. Instead, he found just one type—a dome-shaped bump called an Eimer's organ, repeated again and again, like the surface of a raspberry. Each bump contains mechanoreceptors that respond to pressure and vibration, and nerve fibers that carry those sensations toward the brain. These were clearly touch sensors, and they constituted the entirety of the star. The star is an organ of touch, and touch alone. Squint at it, and you might mistake it for a set of hands reaching out at the world. More or less, that's what it is.[*4]

Close your eyes and press your hands against the nearest surfaces—the seat or floor beneath you, your own chest or head. With each press, a hand-shaped burst of shape and texture resolves in your mind. Press quickly and often enough, and you start to build a three-dimensional model of your surroundings. This is almost certainly what the star-nosed mole does with its nose. As it scurries through its dark underground world, it constantly presses its star against the walls of its tunnels, a dozen times a second. With every press, its environment comes into focus in a starburst of textures. I imagine that each one adds to a continuous model of the tunnel that builds in the mole's mind, like a pointillist image appearing dot by dot.

The mole's somatosensory cortex—the touch center of its brain—is disproportionately devoted to the star, much as a human's touch center is especially devoted to our hands. And just as our somatosensory cortex has clusters of neurons that represent each of our fingers, the mole's has stripes of neurons that correspond to each ray of the star. "You can essentially see the star in the brain," Catania

says.[*5] But when he first discovered this mapping, one aspect of it made no sense. The 11th pair of rays, which are smaller than all the rest, is represented by a massive chunk of neurons, which take up a quarter of the brain region that's used for the entire star. Why should the mole devote the largest amount of processing power to the tiniest of its touch sensors?

By filming the mole using high-speed cameras, Catania and his colleague Jon Kaas realized that it *always* ends up investigating a piece of food with the 11th and smallest pair of rays, even if other parts of the star touch the object first. It will often dab an object several times in succession, each one bringing the 11th pair of rays closer. This is remarkably similar to what we do with our eyes. We make tiny adjustments to focus on objects with our fovea, the part of our retina where our vision is most acute. Similarly, the mole's 11th pair of rays is what Catania calls the tactile fovea—the zone where the animal's sense of touch is sharpest. It's no coincidence that this zone lies just in front of the mole's mouth. The instant it decides that an object feels like food, it can part the 11th pair of rays and seize the morsel with its tweezer-like front teeth.

The mole doesn't stroke or rub or palpate with its star. Whatever it's doing occurs through the simplest of actions: press and lift. That is how the animal might be able to recognize its prey through shape, by comparing how neighboring Eimer's organs are dented or deflected. The mole can certainly distinguish textures, since it'll eat bits of dead earthworm but ignore similarly sized chunks of rubber and silicone. And it can do all of this at a speed that puts even the sea otter to shame.

Catania shows me a video that he filmed from below as a star-nosed mole investigated a glass slide containing a

piece of worm. When the video is slowed by 50 times, I can see the animal dabbing its star against the glass, detecting the morsel, bringing the tactile fovea across to inspect it more thoroughly, and finally swallowing it. In real time, it's impossible to work out what is happening. The mole simply appears, and the worm disappears. By analyzing such footage, Catania and his colleague Fiona Remple found that the mole can identify its prey, swallow it, and begin searching for the next mouthful in an average of 230 milliseconds and as little as 120 milliseconds. That's as fast as a human blink. Imagine that your eye starts to close at the exact moment that a foraging mole first touches an insect with its star. Before your lashes cross the midline of your eye, the mole's brain has already recognized what it has touched and sent motor commands to reposition the star. By the time your eye is fully shut, the mole has touched the insect a second time with its supersensitive 11th rays. By the time your eye is half-open, the mole has processed the information from that second touch and decided on a course of action. When your eye is fully open, the insect is gone and the mole is looking for another.

The star-nosed mole seems to be moving as fast as its nervous system will allow, restricted only by the speed at which information can travel between the star and the brain. That trip takes just 10 milliseconds. Within the same time, visual information can't even make it through the retina, let alone reach the brain or complete the return journey. Light may be the fastest thing in the universe, but light *sensors* have their limits, and the star-nosed mole's sense of touch blows past them all. "It's moving so fast that it's almost getting ahead of its brain," says Catania. He shows me another video in which the mole touches a chunk of worm and begins moving away before changing direction

and scooping up the briefly missed morsel. “It’s on to the next thing before it realizes what it’s just touched,” he says. Sighted people know what it’s like to do a double take after walking past something unexpected. But that’s an easy movement—a simple turn of the head. For a star-nosed mole, sensing the world through touch and not vision, and touching with its face instead of its limbs, a double take is a frenetic full-body affair.

Its speed and sensitivity are linked. With its bizarre nose, the mole can detect and capture small prey like insect larvae. But to subsist on such little morsels, it must scoop up a lot of them as quickly as possible. “They’re little vacuum cleaners,” says Catania. “They eat things so small that you might think: Why even bother?” They bother because they have no competition. Thanks to the star—a nose that works like a hand and scans like an eye—the underground world appears in glorious detail, and abounds with food that its competitors can’t even perceive. A tunnel that might seem like an empty corridor to another mole twinkles with tasty treats under the touch of the star.

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LIKE THE STAR-NOSED mole, many animals that specialize in touch work in conditions where vision is limited. They’re often searching for things that are hidden or hard to find, which forces them to root around with body parts that can probe, press, and explore. Whether we’re talking about a sea otter’s paw or a human’s finger, an elephant’s trunk or an octopus’s arm, animals discover the world by deliberately moving tactile organs over it. And as the mole shows, those organs don’t have to be hands.

The beaks of birds are made of bone and sheathed in the same hard keratin that constitutes your fingernails. They seem inanimate and insensitive—hard, face-mounted tools for grabbing and pecking. But in many species, the tip of the bill contains a smattering of mechanoreceptors, sensitive to vibrations and movements. In chickens, which rely heavily on vision to forage, those mechanoreceptors are relatively rare, and concentrated in a few small clusters on the lower beak alone. But in some ducks, like mallards and shovelers, they're spread all over the bill, upper and lower, inside and out. In some places, these mechanoreceptors are as densely packed as they are in our digits. The mallard's bill may be covered in the stuff of human fingernails, but it's extremely sensitive. Ducks use this sense to find food in murky water. With head submerged and tail aloft, they swirl, strain, and dabble, rapidly opening and closing their bills. They can grab fast-swimming tadpoles in the dark, and filter edible morsels from the inedible mud. " Imagine being given a bowl of muesli and milk to which has been added a handful of fine gravel," wrote Tim Birkhead in his book *Bird Sense*. "How good would you be at swallowing only the edible bits? Hopeless, I suggest, yet this is precisely what ducks can do."[*6]

Many other birds forage by shoving their bills into dark recesses and feeling for food. Such behavior is especially common on shorelines. Even the most deserted beaches are full of buried treasure—worms, shellfish, and crustaceans, all concealed within the sand. To reach this hidden buffet, shorebirds like curlews, oystercatchers, sandpipers, and knots probe among the grains with their beaks. Under a microscope, the tips of their bills are riddled with pits, like corncobs with all their kernels bitten off. Those pits are full

of mechanoreceptors that are similar to those in our hands and allow the birds to detect buried prey.

But how does a shorebird know where to stick its bill in the first place? Subterranean prey aren't obvious from the surface, so one might guess that the birds just probe around haphazardly and hope for the best. But in 1995, Theunis Piersma showed that red knots find shellfish up to eight times more frequently than would be expected if they were doing random searches. They must have a technique. To discover it, Piersma trained the birds to inspect sand-filled buckets for buried objects and to indicate if they'd found anything by approaching a designated feeder. This simple experiment revealed that the knots could still detect clams that were buried beyond the reach of their bills. They could even sense stones, so they clearly weren't relying on smells, sounds, tastes, vibrations, heat, or electric fields. Instead, Piersma thinks that they use a special form of touch that works at a distance.

As a knot's bill descends into the sand, it pushes on the thin rivulets of water between the grains, creating a pressure wave that radiates outward. If there's a hard object in the way—say, a clam or a rock—the water must flow around it, which distorts the pattern of pressure. The pits on the knot's bill tip can sense those distortions, detecting surrounding objects without having to make contact with them. This ability, which Piersma calls "remote touch," is impressive enough, but the knot improves it even further by probing the same areas repeatedly, stabbing its beak up and down several times a second. This stirs up the sand grains, which settle into a denser configuration, heightening the buildup of pressure from the beak and making the distortions more obvious. Every time the knot lowers its head, the food around it becomes more obvious,

as if it were using a kind of sonar based on touch instead of hearing.[*7]

The emerald jewel wasp also has a long, probing organ with a touch-sensitive tip, but its goals and methods are far grislier than a red knot's. The wasp—a beautiful inch-long creature with a metallic green body and orange thighs—is a parasite that raises its young on cockroaches. When a female finds a roach, she stings it twice—once in its midsection to temporarily paralyze its legs, and a second time in its brain. The second sting targets two specific clusters of neurons and delivers venom that nullifies the roach's desire to move, turning it into a submissive zombie. In this state, the wasp can lead the roach to her lair by its antennae, like a human walking a dog. Once there, she lays an egg on it, providing her future larva with a docile source of fresh meat. This act of mind control depends on that second sting, which the wasp must deliver to exactly the right location. Just as a red knot has to find a clam hidden somewhere in the sand, an emerald jewel wasp has to find the roach's brain hidden somewhere within a tangle of muscles and internal organs.

Fortunately for the wasp, her stinger is not only a drill, a venom injector, and an egg-laying tube but also a sense organ. Ram Gal and Frederic Libersat showed that its tip is covered in small bumps and pits that are sensitive to both smell and touch. With them, she can detect the distinctive feel of a roach's brain. When Gal and Libersat removed the brain from a cockroach before offering the roach to some wasps, they repeatedly stung it, trying in vain to find the organ that was no longer there. If the missing brain was replaced with a pellet of the same consistency, the wasps stung it with the usual precision. If the replacement pellet was squishier than a typical brain, the wasps seemed

confused and kept rooting around with their stingers. They know what a brain should feel like.

Both the wasps and their cockroach victims also use their antennae to feel their way around, as most insects do.[*8] Long, sweeping tactile organs are so useful for navigation that many species have independently evolved their own versions.[*9] Humans, ever the tool users, tap the ground in front of them with canes. The round goby, a bottom-dwelling fish, uses supersensitive pectoral fins. The whiskered auklet, a puffin-like seabird, has a large black crest that curves forward from its head, which it uses to feel the walls of the rocky crevices in which it nests.[*10]

Many other birds have stiff bristles on their heads and faces. These are often wrongly billed as nets that help birds to snag flying insects. It's more likely that they're touch sensors, which the birds use when handling prey, feeding chicks, or maneuvering around dark nests. Such uses might explain why birds have feathers at all. It's clear that birds evolved from dinosaurs, and that many dinosaurs were covered in bristly proto-feathers or "dino-fuzz." These structures were too simple for flight, so they must have evolved for some other reason. The most common explanation is that they provided insulation, but that would only be true if they suddenly appeared in large numbers. Alternatively, and perhaps more plausibly, they could have initially evolved to provide tactile information. As the whiskered auklet shows, an animal only needs a few bristles to extend its sense of touch in useful ways. Perhaps feathers first appeared as small clumps on the heads or arms of dinosaurs, helping them first to feel and only later to fly.

Mammalian hair might have had a similar start, appearing first as touch sensors that were only later turned

into insulating coats. Some hairs still retain that original tactile function. They're called vibrissae, from the Latin word for "vibrate." More commonly, they're known as whiskers. They are typically found on the faces of mammals, and are longer and thicker than other kinds of hair elsewhere in the body. Each one sits in a cup that's full of mechanoreceptors and nerves. When the shaft of the whisker is deflected, its base nudges the mechanoreceptors, which send signals to the brain. (You can get a feel for how this works, no pun intended, by closing your hand around the tip of a pen and deflecting the other end away from you.)

Some mammals continuously sweep their whiskers back and forth, several times a second, as they move. This action, delightfully known as whisking, allows them to explore the zone in front of and around their heads. When I first heard about whisking, I underestimated it. It intuitively felt like what I might do when I stumble down a dark corridor—reaching out with my hands to avoid bumping into a wall or to feel for a light switch. But after talking to sensory biologist Robyn Grant, I realize that a whisking mouse or rat uses its vibrissae in a way that's far closer to what I do with my eyes. The rodent constantly scans and re-scans the area in front of it, building up an awareness of a scene. If it senses something with the long, mobile whiskers on its snout, it investigates further with the shorter, immobile whiskers on its chin and lips, which are more numerous and more sensitive. This behavior is similar to that of a star-nosed mole pressing its nose along a tunnel, detecting objects with its star, and finally bringing the small and most sensitive rays into play. It's also similar to a human sweeping their eyes over a scene, detecting

something in their peripheral vision, and focusing on it with their high-resolution foveae.

The similarities to vision don't stop there. If we turn our head, our eyes move first; likewise, a mouse will lead a head turn with its whiskers. Just as we map the world through the pattern of light falling across our retinas, a mouse can map its world by the patterns of touch across its array of whiskers. Each connects to a different part of the somatosensory cortex, so the mouse knows which whiskers have made contact with an object. And since it also knows what orientation those whiskers are in, "it can make maps of what it touches," Grant tells me. The information that builds those maps must flicker in and out as the whisker tips move. But Grant says that a mouse's brain probably interprets these discrete touches in a seamless way. I wonder if whisking for them is like vision for us—an experience that feels uninterrupted even though our eyes are constantly darting and blinking.

Mammals have been using whiskers for almost as long as mammals have existed.[*11] Today, rats and opossums, which share the habits of their small, nocturnal, climbing, scampering ancestors, still whisk. Guinea pigs do it half-heartedly. Cats and dogs don't do it at all, although their whiskers are still mobile. Humans and other apes have lost our whiskers entirely and invested instead in sensitive hands. Whales and dolphins are born with whiskers, but these quickly fall out except around the lips and blowholes. Whisking, after all, is too difficult to do in the water. *Whiskers,* however, can still be useful.

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TWO FLORIDA MANATEES live at the Mote Marine Laboratory in Sarasota. As we stare at them, Gordon Bauer tells me that one, Hugh (as in Hugh manatee), is hyperactive. The other, Buffett (after Jimmy, not Warren), is sluggish and a little overweight. I confess to him that I'm struggling to work out which is which. Their 3-meter bodies seem equally rotund and their dispositions equally languid. After a while, though, I notice that one of them is slowly circling around his tank, performing what I guess is the manatee version of a zoomie. That's Hugh.

In the wild, manatees would spend their time trundling along shallow seabeds, grazing on underwater plants. In captivity, Hugh and Buffett devour around 80 heads of romaine lettuce every day. Hugh is currently going to town on one of these, slowly rending it apart. Sometimes he holds it between his flippers. Other times he grips it with his face, and specifically with the bit between his upper lip and nostrils. This large area, known as the oral disk, gives manatees the hangdog expression that makes them so endearing. And unlikely though it might seem, it is also an extraordinarily sensitive organ of touch.

The disk is muscular and prehensile, more like an elephant's trunk than a typical lip. By flexing and flaring the oral disk, a manatee can handle and investigate objects with the same dexterity and sensitivity as a hand. This is called oripulation—manipulation done with a mouth. Manatees will oripulate everything in their environment, from anchor lines to human legs. Sometimes this lands them in trouble: Florida manatees, which are endangered, get caught in ropes and crab traps because of their habit of exploring everything face-first. More often, oripulation cements their relationships. "Whenever they meet, they'll

oripulate each other's faces, flippers, and torsos," says Bauer.

Reader, Hugh oripulated me. While Buffett took part in an experiment, Hugh was chilling out in a separate part of their enclosure. He lay on his back while a trainer held his flipper and popped beets into his mouth. I leaned over, and he exhaled sweet-scented breath over my face. I put my hand in the water in front of him, and he immediately began exploring it with his oral disk. It felt strange, this meeting of two tactile organs—my hand and Hugh's oral disk, both incredibly different but both devoted to the same sense. I can only imagine what I felt like to him—softer perhaps than the vegetables he eats, but smoother than the skin of his brother Buffett. To me, oripulation felt like being licked by a dog, except with no tongue involved—only prehensile lips, which danced over my palm. My fingertips soon felt like they'd been lightly sandpapered because many of Hugh's whiskers are stubbly.

Those whiskers—vibrissae—are the key to the oral disk's sensitivity. There are around 2,000 of them. Some are long, thin, and bristly. Others are short and spiky, like broken toothpicks. When the oral disk is relaxed, these whiskers are lost among the fleshy folds. But when it's time to eat or explore, the manatee flares and flattens the disk, extending the whiskers outward. By flexing it in just the right way and moving the whiskers against each other, a manatee can clip grasses and shred lettuces. "They can grab food and bring it into their mouth, but also take things like pebbles out," Bauer says. His colleague Roger Reep once filmed a manatee eating a plant with one side of its mouth while using the other to remove what it didn't want to swallow. By pressing these hairs against an object, a manatee can take the measure of its texture and shape, like a whisking

rodent, only much slower. In 2012, Bauer tested Hugh and Buffett to see if they could distinguish between plastic boards with differently spaced ridges, much as Sarah Strobel later did with Selka the sea otter and various human volunteers. The two manatees performed just as well as the other species.[*12] Their faces were the equals of human fingertips.

Manatees are the only known mammals that *only* have vibrissae and no other kinds of hair. Aside from the whiskers on their oral disk, they have another 3,000 scattered all over their large bodies. Thin and widely spaced, they are hard to see at first, but I eventually catch a glimpse of Hugh's, glinting in the daylight. "Every once in a while, when the sun is just right, they look like a field of wheat," says Bauer.[*13] Manatees use these body-wide whiskers for another purpose—to sense the water flowing around them.

Sensory hairs are versatile structures. They can be actively pressed against surfaces to produce tactile sensations, as whisking rats and oripulating manatees do. But they can also be passively bent and deflected by flowing air or water. By responding to that pressure, an animal can detect the flows created by distant objects, touching things from afar without needing to make direct contact. Manatees can certainly do this. Bauer and his colleagues showed that Hugh and Buffett could use their body whiskers to detect the minute vibrations of a sphere that was shaking in the water. The animals were blindfolded, their facial whiskers were covered, and the sphere was positioned a meter away from their flanks. They sensed it nonetheless, even when it was displacing the water by less than a millionth of a meter.

In the wild, they probably use this “hydrodynamic” sense to judge the direction of a current, to work out what other manatees are doing, or to detect the approach of other animals. They successfully keep their distance from snorkelers even though their eyesight is notoriously bad. They often swim upstream from estuaries just as the tide starts to come in. They rest on the seabed in groups and then suddenly rise as one for a breath. Their eyes might be small, and the water around them might be turbid, but they perceive their surroundings through a distributed and distant version of touch. They can tap into the hidden signals that I hinted at earlier—the invisible currents of information that flow around us, and which animals can detect with the right sensory equipment.

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AT THE LONG Marine Lab where Sarah Strobel worked with Selka the sea otter, a harbor seal who goes by Sprouts is floating on his back in a pool. Colleen Reichmuth calls to him, and he hauls his gray, mottled body out of the water. She asks him to speak. He unleashes a startlingly loud noise that sounds like a cross between a roar and a foghorn. “BUH-WAH-WAH-WAH-WAH-WAH-WOOOAAAARRRR,” he seems to say. I put my hand on his chest, and I feel the rumble through my entire arm. Underwater, where his song is much louder, it can feel like a punch.

Seals, sea lions, and walruses—the group of animals collectively known as pinnipeds—are often ignored by scientists in favor of more popular marine mammals like whales and dolphins. But Reichmuth has always been fascinated by them, perhaps because they, like her, must

split their time between land and sea. “I grew up swimming and I always wanted to be in the water,” she says. “I was drawn to these creatures that could just kind of switch back and forth between these two lives.” Reichmuth came to the Long Marine Lab in 1990 and has worked there ever since. She has known Sprouts for all of that time: He arrived at the facility a year earlier, shortly after his birth at SeaWorld San Diego. He’s approaching his 31st birthday when I meet him, which is well past the life span of male harbor seals in the wild. His old eyes have cataracts, and he can barely see. But that’s not a problem: Thanks to their whiskers, blind harbor seals can still thrive, even in the wild.

Sprouts has around a hundred facial whiskers protruding from his snout and his eyebrows. When he looks at me full-on, they form a stiff radar dish around his face. Sprouts can use them to discriminate shape and texture, to sense vibrations in the water, and to avoid obstacles. When he dives back into the water, his whiskers brush along the sides of his tank, allowing him to closely follow the curving wall without ever bumping into it. “But if we were to throw a fish in there, he would have a really hard time finding it,” says Reichmuth. “Unless it started swimming.”

As a fish swims, it leaves behind a hydrodynamic wake—a trail of swirling water that continues to whirl long after the animal has passed. Seals, with their sensitive whiskers, can detect and interpret these trails.[*14] This ability was only discovered in 2001, by Guido Dehnhardt and his team at Rostock, Germany. They showed that two harbor seals, Henry and Nick, could follow the underwater path of a mini-submarine. They clung to the trail even when their eyes were blindfolded and their ears were plugged by headphones. Only when their whiskers were covered by a

stocking did they lose the sub. At the time, most researchers believed that hydrodynamic senses would only work over short distances. The disturbances created by moving underwater objects ought to die away so quickly that beyond a range of a few inches, they would be undetectable. But hydrodynamic wakes can actually persist for several minutes. Dehnhardt estimated that a swimming herring should leave a trail that a harbor seal could follow from up to almost 200 yards away.

Sprouts might be getting on in years, but his hydrodynamic sense is still sharp. Reichmuth tests it using a ball that's mounted on the end of a long pole. She walks around the edge of the pool, moving the ball through the water in a sinuous trail. After a few seconds, Sprouts, who was waiting patiently, gets the green light. He searches around, sweeping his whiskers from side to side. As soon as they make contact with the ball's wake, Sprouts instantly turns and follows it. He isn't just heading in the rough general direction. He's following the *exact* path of the ball in minute detail, up and down, in and out, as if pulling himself along an invisible rope. He can't be relying on vision—even if his eyes weren't so old, he's wearing a custom-made blindfold. Instead, he's picking up on a track of invisible whirling vortices temporarily imprinted into the water. When he starts to stray beyond the trail, he moves his head from side to side to find its edge, just as a snake might do with its forked tongue. When the trail crosses a gushing water pipe, he temporarily loses it, but quickly picks it up again on the other side.[*15] When the trail turns back on itself, so does Sprouts. In watching Sprouts, I'm reminded of Finn the dog sniffing his way along odor trails and following the scents of previous passers-by. To us, touch is rooted in the present, in the instants when a

sensor makes contact with a surface. But to Sprouts, touch extends into the recent past, just as smell does to Finn. His whiskers can feel what was, rather than simply what is.

This ability seemed impossible back when Dehnhardt first discovered it. As a seal swims, its whiskers should produce their own swirling vortices of water. These ought to vibrate the whiskers and drown out the subtler signals produced by the wakes of distant fish. But harbor seals have an answer to this problem, which becomes clear when Sprouts sticks his head out of the water. Looking closely at his whiskers, I can see that they're slightly flattened and angled so that the bladed edge always cuts into the water. They aren't smooth, either. At first glance, they look like they're covered in beads of water. But as I run my finger over them, I realize that they're dry, and that the "beads" are part of the whiskers' actual structure. They have an undulating surface that repeatedly widens and narrows along their entire length. The Rostock team showed that these shapes dramatically reduce the vortices left by the whiskers themselves. Through this quirk of anatomy, seals can tone down the signals from their own bodies and enhance those left by their prey. These flattened, undulating whiskers aren't found in walruses, which use their numerous vibrissae to feel out buried shellfish. They aren't found in sea lions, which are still strongly guided by vision. They're unique to seals, which are consequently better at following hydrodynamic wakes than other pinnipeds.[*16]

Having shown off his skills, Sprouts sinks to the bottom of his tank and lies there, waiting. Harbor seals do this in the wild, too. They'll lurk in the darkness of a kelp forest using their radar dish of erect whiskers to detect the wakes of passing fish. From those impressions alone, the seal can

tell in which direction a fish was swimming. It can discriminate between the wakes left by objects of different sizes and shapes, which might help it to pursue only the largest and most nutritious individuals. It might not need a wake at all. In one experiment, Henry and other seals at Rostock could detect gentle currents rising from the seabed, as might be produced by the gills of buried flatfish. Those fish might be camouflaged and lying perfectly still, but a seal can still feel their breaths with its face. A seal's tactile world is attuned to flow and motion, and their prey cannot help but move. It would seem like an unfair contest, if those prey didn't have incredible hydrodynamic powers of their own.

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WHEN SEALS AND other underwater predators charge at a group of fish, the school moves as one. The fish don't flee in random directions. They don't collide with each other. They seem to flow around their attackers like the very water in which they're immersed. This miraculous feat of coordination depends partly on vision. But it also depends on a system of sensors called the lateral line.

The lateral line is found in all fish (and some amphibians). It usually includes a smattering of visible pores on a fish's head and flanks, along with fluid-filled canals running just below its skin. After describing the pores in the seventeenth century, scientists spent 200 years thinking that they mostly secreted mucus. But on closer inspection, they noticed small groups of pear-shaped cells, capped in a gelatinous dome. These structures, now called neuromasts, were obviously sensors. In the 1930s, the biologist Sven Dijkgraaf showed that blind fish can use

their lateral lines to detect the currents produced by objects moving nearby.[*17] More impressively, he showed that they could also detect stationary objects by analyzing the currents that they themselves produce.

A swimming fish displaces the water in front of it, creating a flow field that envelops its body. Obstacles distort that field, and the lateral line can detect those distortions, providing the fish with a hydrodynamic awareness of its surroundings. If it swims toward an aquarium wall, the wall "prevents the water particles giving way as freely as in unobstructed water," Dijkgraaf wrote, and "the fish will experience an 'unexpected' rise of water resistance." This is similar to the technique that red knots use to locate buried clams, and it's likely how manatees perceive whatever's in the turbid water around them. But fish had been using their lateral lines to feel at a distance for hundreds of millions of years before either manatees or knots existed, and they are far more sensitive to water movements.[*18]

With the lateral line, fish can feel the rich sources of information that are literally flowing around them. This awareness extends in almost all directions, for up to a body length or two away, which Dijkgraaf described as "touch at a distance." Humans can feel strong water currents flowing over our skin, but "I don't think that even gets close to the rich perceptions that fish must have through their lateral line," says Sheryl Coombs, who has been studying this system for decades. When we walk down the street, patterns of brightness and color move over our retinas, and we perceive our surroundings flowing past us. Perhaps a fish gets a similar experience from the patterns of water moving over its lateral line. They can certainly use those patterns to orient in flowing water, find prey, escape from

predators, and keep tabs on each other. Schooling fish use their lateral lines to match the speed and direction of their nearest neighbors. When a predator lunges, the rush of incoming water triggers the lateral lines of the nearest individuals, which dart away. Their startled movements trigger the lateral lines of their neighbors, which trigger their neighbors, and so on. Waves of panic spread outward, and the school seamlessly parts around the predator. Each fish only attends to the small volume of water around it, but the sense of touch connects them all and allows them to act as a coordinated whole. Blind fish can still school.

Though all fish share the same basic neuromast structure, many of them have expanded and tweaked the lateral line in unusual ways. Surface-feeding fish have flattened heads loaded with neuromasts, which detect the vibrations of insects falling on the water's surface. Halfbeaks have massive underbites, and the neuromasts that line their protruding lower jaws can tell them if prey are swimming in line with their mouths. Blind cavefish have lost their sight and use exceptionally large, numerous, and sensitive neuromasts to find their way around.[*19] And some fish, unexpectedly, have almost lost their lateral lines altogether.

In 2012, Daphne Soares, a lover of both caves and unusual animals, traveled to Ecuador to see a blind catfish called *Astroblepus phoeleter,* which lives in a single cave and is so obscure that it has no common name. Examining it under a microscope, she expected to find giant and exceptionally sensitive neuromasts, like the ones found in many cave-dwelling fish that have dispensed with vision. Soares was shocked to find barely any neuromasts at all. Instead, the animal's skin was covered in what looked like little joysticks, the likes of which she had never seen

before. “That’s the reason I’m in science—that feeling of: I wonder what this is,” she says.

Soares showed that the joysticks are mechanosensors. More unexpectedly, she learned that they’re *teeth*. They’re not tooth-like structures—they’re actual teeth, made of enamel and dentine, with nerves coming out of their bases. While most catfish have expanded their taste buds to cover their bodies, this cave species has done the same with its teeth, turning them into a body-wide coat of flow sensors. That seems like a strange innovation for an animal whose ancestors would already have had a fully functioning lateral line. But Soares notes that these catfish live in a cave that experiences torrential floods on an almost daily basis. Those raging currents, she thinks, might have overwhelmed the lateral line, forcing the fish to evolve stiffer sensors. They now use their skin-teeth to find calm zones, where they can wait out the torrents by sticking to rocks with their sucker-like mouths. Soares is now studying other cavefish to see if they, too, have strange touch sensors.[*20] “I like weird animals,” she tells me. “The more extreme or ancient or unique, the better.”

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IN THE SUMMER of 1999, before cavefish came into her life, Soares was sitting in the back of a pickup truck, next to a large alligator that had been collected by the U.S. Fish and Wildlife Service. During the long ride, she got a good look at her companion’s taped mouth. That’s how she first noticed the bumps.

Alligators have rows of dark, raised domes along the edges of their jaws, as if they’re wearing beards made of blackheads. Scientists first described these bumps in the

nineteenth century, but no one knew what they were for. “I thought they have got to be some sort of sensory things,” Soares says. Back in her lab, she found that the bumps contained nerve endings. But she couldn’t find any hairs, pores, or other obvious sensory structures that might stimulate those nerves. Working with sedated alligators that were lying in water, Soares tried exposing the bumps to light, electric fields, or bits of smelly, tasty fish. The nerves didn’t react. Then, one day, she reached into the water to retrieve a tool that she had dropped. As her hand broke the surface, it caused ripples. And when these ripples hit the alligator’s face, the nerves in its bumps finally started to fire. “I called my friends over to confirm that I wasn’t hallucinating,” Soares tells me.

The bumps, she discovered, are pressure receptors that can detect vibrations at the water’s surface. They might work like little buttons, akin to the Eimer’s organs on moles. They’re so sensitive that if Soares let a single drop of water fall into an (unsedated) alligator’s tank, the animal would turn and lunge toward the disturbance, even when its eyes and ears were covered. But if Soares covered its snout in a plastic sheet, the drops went unnoticed. The animals use the bumps to scan the thin horizontal layer where air and water meet. They sit in ambush in that layer, waiting for something to land in the water or to arrive at its edge for a drink. This strategy demands stillness, so they can’t engage in the comparatively hectic explorations of moles, mice, or even manatees. Unmoving, they use their touch sensors to monitor everyone else’s movements.[*21]

These bumps might detect more than the ripples of prey. When male alligators want to attract mates, they produce deep-throated bellows. These vibrate the water above their backs, causing it to dance and sputter like oil on a sizzling

pan. Other alligators might be able to sense these vibrations through their delicate faces. The bumps are also found around the teeth and inside the mouth, so crocodilians might use them to assess their food or adjust their bites. When they forage underwater by sweeping their jaws around, the bumps could tell them when they've hit upon something edible. When a mother croc hears the cries of infants about to hatch, she might use the bumps to deliver just enough force to crack the eggs. When she carries her hatchlings around in her jaws, her fine sense of touch might help her to distinguish between prey she should bite and babies she should not.

This goes against every stereotype one might have about crocodiles as brutish, unfeeling animals. With jaws that can crush bone and thick skin that's heavily armored with bony plates, they seem like the antithesis of delicacy. And yet, they are covered head to tail in sensors that, as Ken Catania and his student Duncan Leitch showed, are 10 times more sensitive to pressure fluctuations than human fingertips.

What other organs of touch might people have missed because they exist in creatures that seem insensitive? Many snakes have thousands of touch-sensitive bumps on the scales of their heads. These bumps are especially common and prominent in sea snakes, which might use them as hydrodynamic sensors much as crocodilians seem to do. *Spinosaurus,* an enormous sail-backed dinosaur, had pores at the tip of its snout that resemble the holes in a crocodile's skull and that might have also allowed nerves to pass into pressure-detecting bumps. *Spinosaurus* had a crocodile-like face and has often been depicted as a semi-aquatic fish-eater; perhaps it also used touch sensors to feel for rippling prey. *Daspletosaurus,* a close relative of

Tyrannosaurus, also had telltale holes in its jaws and might well have been covered in sensory bumps. These dinosaurs didn't live in water, but perhaps they rubbed their sensitive faces during courtship, or used them to carry their young in their mouths. Such speculations might sound far-fetched, but perhaps they shouldn't when we think about the bumps of crocodiles, the lateral lines of fish, or the whiskers of seals. Science has a long track record of underestimating or overlooking touch and flow sensors—including ones that were sitting in full view.

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FEW BIRDS ARE more recognizable or ostentatious than the peacock. But ignore, if you can, the gaudy iridescent tail. Focus instead on the stiff, spatula-like feathers that form a crest on their heads. These are utterly conspicuous, but often ignored. To find out if they have a purpose, Suzanne Amador Kane acquired several of them from aviaries and breeders, plus one unfortunate zoo peacock that flew into a polar bear enclosure. Her student Daniel Van Beveren then mounted the crests on a mechanical shaker, and watched as they wobbled to and fro. When shaken at exactly 26 Hz—that is, 26 times a second—they moved with exceptional vigor. That's their resonant frequency. It happens to be the *exact* frequency at which a courting male peacock shakes his tail feathers. That, Kane tells me, "couldn't possibly be a coincidence." Van Beveren played different recordings to his mounted peacock crests. When he put on a clip of an actual peacock rattling his tail, the crest feathers resonated. When he put on other recordings, including "Staying Alive" by the Bee Gees, they did not.

These results suggest that a peahen that stands in front of a courting male might be able to detect the air disturbances produced by his tail. As well as seeing his efforts, she might *feel* them. (This also works in reverse, since females will sometimes display back to males.) Kane now wants to prove this idea by filming the crests of living courting peacocks to see if they actually shake at the same frequencies.[*22] If they do, it would mean that a peacock's display, despite its flamboyance, has always had a secret component that was inconspicuous to human observers. We just don't have the right equipment to fully appreciate it. And if we're missing something in one of the most flamboyant exhibitions in the animal kingdom, then what else are we missing?

A clue can be found at the base of each peacock crest feather, where there's a smaller companion feather called a filoplume. It's just a simple shaft with a tufted tip, and could act as a mechanosensor. When moving air shakes the crest feather, the crest feather could nudge the filoplume, and the filoplume could trigger a nerve. Filoplumes are found in most birds, and are almost always associated with another feather. Birds can use them to monitor the position of their feathers, perhaps to sense when their smooth plumage has become ruffled and needs to be preened. But filoplumes are especially important during flight.

Bird flight looks so effortless that it's easy to forget just how demanding it is. To stay aloft, birds continuously adjust the shape and angle of their wings. If they get everything right, air flows smoothly over the contours of each wing, producing lift. But if they hold their wings at too steep an angle, the smooth flows form turbulent vortices and the lift disappears. This is called stalling, and if the bird can't avoid or correct it, it will drop out of the sky. This rarely

happens, in part because filoplumes provide birds with the information they need to rapidly adjust their wings and stay in the air. Which is, frankly, incredible. I remember once standing on a boat and watching a gull fly alongside me. It was windy, and we—the boat and the bird—were moving fast. As I held my hand out and felt the air blow over and between my fingers, I marveled that the gull's wing could shape those same currents and keep it aloft. But I didn't realize all the bird was doing—that it was also using its filoplumes to read the air around it and make tiny adjustments to its flight. The French ophthalmologist André Rochon-Duvigneaud once wrote that a bird is a "wing guided by an eye," but he was wrong—the wings also guide themselves.

The same could be said about bats. Their membranous wings are very different from the feathered ones of birds, but are no less sensitive. They are covered with a smattering of touch-sensitive hairs, protruding from small domes and connected to mechanoreceptors.[*23] Susanne Sterbing showed that most of these hairs react only to air that flows from the back of the wing to the front, which typically occurs when the wing is about to stall. Bats, like birds, can sense those moments and take corrective measures. Thanks to their hairs, they can bank steeply, hover, backflip to catch insects in their tails, and even land upside down. When Sterbing treated bat wings with hair removal creams and flew the animals through obstacle courses, the effects were obvious. They never crashed, but they kept a wide distance from the objects around them, and their turns were wider and clumsier. By contrast, with their hairs intact, they could fly within inches of obstacles and pull off hairpin turns. For them, airflow sensors make the difference between flying and flying acrobatically.

For other animals, however, such sensors mean the difference between life and death. Perhaps that is why they have evolved into some of the most sensitive organs in the world.

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IN 1960, A shipment of bananas arrived at a marketplace in Munich, Germany. It had come from somewhere in Central or South America, and had brought with it a few hitchhikers—three large spiders, each as big as a hand. The spiders were sent to the University of Munich, where a scientist named Mechthild Melchers began studying and breeding them. The species, now known as the tiger wandering spider for the black and orange stripes on its legs, has since become the most thoroughly studied spider in the world.

The tiger wandering spider doesn't spin a web to catch food; instead, it sits in wait for its prey. Its legs are covered in hundreds of thousands of hairs, which are packed so densely that there can be 400 in a square millimeter. Almost all of them are connected to nerves and are sensitive to touch. Prod just a few on a single leg, and the spider will either withdraw its limb or turn to investigate. If it is running and its hairs brush against an object—say, a wire strung across its path by a curious scientist—the spider will arch its body and scurry over the obstacle. During courtship, a male might stimulate a female's hairs in just the right way to prevent her from eating him.

Most of these hairs only respond to direct contact, but some are so long and sensitive that they will also be deflected by the wind. These are called trichobothria, from the Greek words for "hair" (*trichos*) and "cup" (*bothrium*).

Like a bird's filoplumes or a fish's neuromasts, they're flow sensors—albeit exceptionally sensitive ones. Even air that's moving at just an inch per *minute*—a breeze so gentle it could hardly be called a breeze—will deflect them. Watch them under a microscope, and you'll see them fluttering away under the influence of imperceptible currents, while everything around them is still. With a hundred trichobothria on every leg, the tiger wandering spider can tune in to the airflow around its body, in every possible direction. It uses this sensitivity for lethal ends.

In its rainforest home, the spider spends the day hiding within the leaf litter and only emerges half an hour after sunset. It walks onto a leaf and waits. As the darkness intensifies, gusts of wind become rare, and the steady ambient airflow is dominated by low frequencies that the spider ignores. Its trichobothria are tuned instead to the higher frequencies produced by airborne insects, like a fly zooming toward the spider. The fly might be minuscule, but it still pushes air ahead of it. At first, the spider can't distinguish that moving air from the background flow. But once the fly is about 1.5 inches away, its air signal becomes noticeable, like a silhouette emerging from a fog. The trichobothria on the leg closest to the fly start to move before those on the other seven, and sensing this difference, the spider turns to face its incoming prey. As soon as the fly moves over one of its legs, it deflects the trichobothria from straight overhead, and the spider jumps. It grabs the fly from the air with its front legs, drags it to the ground, and delivers a venomous bite. "It's even able to correct its path while jumping," says Friedrich Barth, who has been studying the spider since 1963 and has watched its jumps many times over. "I've always thought about how difficult it would be to build a robot to do this."

Insects aren't helpless, though. Many have airflow sensors of their own. Wood crickets have a pair of spines called cerci that protrude from their rear ends. These are covered in hundreds of hairs that are just as sensitive as a spider's trichobothria, if not more so. These so-called filiform hairs can detect the current produced by a wasp's wingbeats. And, as Jerome Casas has shown, they can detect the infinitesimal wind created by a charging spider.

The wolf spider is the cricket's major predator and runs down its prey. On the uneven, leaf-strewn floor of a forest, it must launch its attacks while standing on the same leaf as its target. It is fast, but Casas found that the cricket's hairs can sense it almost as soon as it starts to run. Indeed, the faster the spider moves, the more detectable it becomes. Its only hope is to sneak up on the cricket, moving so slowly that it barely disturbs the air in front of it, and getting close enough for a final lunge. Even then, its odds of success are just 1 in 50. "The cricket almost always wins," Casas tells me. "As soon as it jumps away from that leaf and lands somewhere else, the game is over. It's on another world."[*24]

The filiform hairs of crickets and the trichobothria of spiders are almost inconceivably sensitive. They can be deflected by a fraction of the energy in a single photon—the smallest possible quantity of visible light. These hairs are a hundred times more sensitive than any visual receptor that exists, or could *possibly exist*. Indeed, the amount of energy needed to shift a cricket's hairs is very close to thermal noise—the kinetic energy of jiggling molecules. Put another way, it would be almost impossible to make these hairs more sensitive without breaking the laws of physics.

So why doesn't everything in the world set them off? Why aren't spiders constantly leaping at imagined insects,

or crickets constantly fleeing from phantom spiders? Partly, the hairs only respond to biologically meaningful frequencies—the kind produced by predators or prey, and not by the environment. The mechanoreceptors at the base of the hairs are also less sensitive than the hairs themselves and need stronger stimulation before they fire. Finally, no single hair will send the spiders into action. Animals rarely respond to the excited buzz of a single mechanoreceptor. Instead, they listen to the entire chorus.

Why, then, is each hair so sensitive? The obvious explanation is that long arms races between predators and prey have led to the evolution of sensors that detect the faintest possible signals. “But that’s a bit of an easy answer, and I’m not totally convinced,” says Casas. As a biologist, he’s used to talking about optimization, where animals make the best of what they’ve got given the many constraints they face. But the cricket hairs are a rare example of *maximization,* he says. “They almost couldn’t be better than they are, and that’s surprising. No one really knows why.”[*25]

Most arthropods—the diverse group that includes insects, spiders, and crustaceans—have hairs that detect the flow of either water or air. The implications of this widespread sense are profound, in ways we have barely begun to grapple with. For example, in 1978, Jürgen Tautz showed that caterpillars can use hairs on their midsection to sense the air movements produced by flying parasitic wasps. They react by freezing, throwing up, or falling to the ground. Thirty years later, Tautz showed that flying honeybees can trigger the same effect. Simply by moving the air around the plants that they visit, bees can reduce the amount of damage that very hungry caterpillars might inflict. Few groups of insects matter more to plants than

bees and caterpillars. And yet no one appreciated that these groups—the pollinators and the despoilers—are connected by the slightest gusts of wind and the minuscule deflections of hairs. The air around us is full of signals that we don't detect. And so is the ground below us.

SKIP NOTES

*1 Orphaned and stranded when she was one week old, Selka was rescued in 2012 and brought to Monterey Bay Aquarium, where she was raised by one of its resident sea otters. After months of learning how to otter, she was released, but after just eight weeks, she was brutally attacked by a shark. The aquarium took her back, fixed her wounds, and released her again. But after a bout of toxic shellfish poisoning and signs that she had become too habituated to humans, the U.S. Fish and Wildlife Service decided that she was "too likely to interact with humans to be safe in the wild." She spent two years in the Long Marine Lab before finally returning to Monterey Bay Aquarium, where she now acts as a surrogate mom to other orphaned pups.

*2 Aristotle once wrote that "in the other senses man is inferior to many animals, but in the sense of touch he far surpasses them all in acuity." He had never heard of sea otters, but he wasn't too far off in his claims.

*3 Mark Rutland, who led the study in which volunteers distinguished between ridges that differed in height by 10 nanometers, said that "if your finger was the size of the Earth, you could feel the difference between houses [and] cars." That's true, but only if you dragged your planet-sized digit down the street—an act that, ironically, would be rather insensitive.

*4 You might think that the rays of the star grow outward from the mole's nose. That's not the case. A star-nosed mole embryo has tiny swellings on the side of its snout, which gradually lengthen into cylinders. These are the future rays of the star. When the mole is born, the cylinders are still attached to its face. Slowly, skin starts to grow beneath them, separating them from the underlying tissue. After roughly a week, the rays break free and spring forward. A star is born.

*5 Around 5 percent of star-nosed moles have mutant noses with either 10 or 12 pairs of rays. Their brains have the corresponding number of stripes.

*6 Some are especially good at this. Elena Gracheva (the scientist who studies thirteen-lined ground squirrels) and her husband, Slav Bagriantsev, showed that the Pekin duck, an animal that we domesticated from wild mallards and now breed exclusively for meat, is a touch specialist. Compared to other ducks, it has a wider bill, more mechanoreceptors in that bill, and more neurons that carry signals from those mechanoreceptors. More surprisingly, it also has fewer neurons for sensing pain and temperature. Sensory abilities don't come for free, so to become masters of fine touch, mallards had to sacrifice other kinds of tactile sensations.

*7 Inspired by Piersma's discovery, Susan Cunningham showed that distantly related birds also use remote touch. Ibises use the technique when probing through muddy wetlands with their long, sickle-like beaks. New Zealand's kiwis do the same through leaf litter.

*8 Insects evolved from ancestors that had many body segments, each with its own pair of legs. Over time, several of the frontmost segments fused to create the insect head, and their respective limbs were transformed into either mouthparts or antennae. The antennae are essentially repurposed legs, or sensory limbs.

*9 Tactile organs don't have to be long or sweeping. The remoras, or suckerfishes, have transformed their dorsal fins into suction cups, which they use to cling to the undersides of larger fish. That sucker is full of mechanoreceptors, which might tell the fish when it has made contact with a host.

*10 When Sampath Seneviratne placed some auklets in a dark maze and taped down their crests and whiskers, they were more likely to bump their heads.

*11 Grant showed that the opossum—a marsupial—also whisks, and controls its vibrissae using muscles very similar to those used by a mouse. These distantly related species belong to branches of the mammalian family tree that separated shortly after the group first evolved. This suggests that the earliest mammals actively explored their world through whisking.

*12 Buffett did slightly better, which Bauer attributes to Hugh's shorter attention span.

*13 A few other mammals have body-wide whiskers, including the naked mole-rat and the hyraxes—small creatures that look like marmots but are in fact the closest relatives of elephants and manatees. These hairs probably help mole-

rats and hyraxes to detect the walls of cramped tunnels and rocky crevices, much like the whiskered auklet.

*14 The seals actively keep the whiskers warm, even when diving in freezing water. This stops the tissues from stiffening and allows the whiskers to move freely. They pay a price for this. Sense organs can't usually be insulated in the same way that internal organs can. They have to be close to the surface, and thus often leak heat. To keep these organs heated in icy water is like powering a radiator that's situated in a doorway. The fact that the animal bothers says something about how valuable these organs are.

*15 For obvious reason, the U.S. military funds studies like these, in the hope of creating instruments that can also track stealthy objects that are moving underwater. "Can you build devices that mimic the biological capabilities of an animal like this one?" says Reichmuth, pointing at Sprouts. "The answer so far is no."

*16 Bearded seals are an exception that proves the rule. Their many whiskers are also simple and cylindrical, because they, like walruses, are bottom-feeders that root around for prey. They don't need a particularly strong hydrodynamic sense.

*17 In 1908, the ichthyologist Bruno Hofer came close to working out what the lateral line did. He noticed that a blind pike could still avoid collisions and react to water currents as long as its lateral line was intact. Hofer correctly deduced that the organ allowed the pike to "feel at a distance" by sensing the flow of water. Unfortunately, he published his claim in an obscure and short-lived journal that he himself had founded and that hardly anyone read.

*18 In 1963, Dijkgraaf summarized his work in a seminal paper, which argued that the lateral line is a "specialized organ of touch," analogous to the vibrissae of mammals. In a nice bit of conceptual turnabout, when the hydrodynamic abilities of the manatee's body vibrissae were first discovered, they were billed as a mammalian equivalent of the lateral line.

*19 Some blind cavefish have evolved a unique style of swimming where they alternate between rapidly kicking forward and gently gliding along. The kicks provide propulsion but swamp the lateral line. The glide is slower but generates a stable flow field that makes surrounding objects easier to discern.

*20 One of these is a Chinese fish called *Sinocyclocheilus*. Between its long, upturned snout and a mysterious forward-pointing hump on its back, it looks

like a cross between a fish and an iron. Its lateral line is normal, but Soares suspects that the horn might somehow sensitize the neuromasts by creating a bow wave ahead of the fish. It'll take more work to confirm that idea, but Soares is keen to start.

*21 Crocodilians—alligators, crocodiles, and their relatives—weren't always aquatic. They and their extinct relatives have been around for some 230 million years, and many of those ancient species were land-living creatures that prowled like cats or galloped like horses. It's hard to know what senses these prehistoric animals possessed, but their skulls provide a clue. If they had the same ripple-detecting bumps as modern crocodilians, they would also have had telltale holes in their jaws through which nerves would have passed. Some of them did—but not all of them. Crocodilians only evolved the pressure-sensitive bumps when they started transitioning to life in the water.

*22 That's easier said than done since a female's crest is green and is usually in front of green foliage. But Kane knows some breeders who have white peacocks, and discussions are afoot.

*23 Too short and thin to be seen with the naked eye, these hairs are not for insulation. In 1912, scientists suggested that they could be airflow sensors that allowed bats to fly in darkness. But once people realized that bats use a kind of sonar to navigate, interest in their tactile sense dropped, until Susanne Sterbing reignited it in 2011.

*24 This ability resembles Spider-Man's spider-sense, which warns him of danger. In some movies, the spider-sense is represented by small hairs that stand up on Peter Parker's arm. But as Roger Di Silvestro wrote on the National Wildlife Federation's blog, " Spiders can detect danger coming their way with an early-warning system called eyes."

*25 Does this airflow sense count as touch at a distance, as it is often described? Is it some version of hearing, which also relies on hairs that respond to movements of air? Opinion is divided. Casas thinks it has elements of both. Barth feels that it's a distinct sense in its own right. I personally find it hard to categorize without knowing more about what the animals are actually experiencing. How does the airflow of a distant fly feel to a spider compared to a wire directly brushing its leg? Do these feel as distinct as, say, hot or cold to us, or are they two ends of the same spectrum of tactile sensations?

7.

The Rippling Ground

Surface Vibrations

In 1991, KAREN WARKENTIN WAS living the dream. They loved frogs and snakes, and as a new PhD student, they had somehow ended up in a place with plenty of both—Costa Rica's Corcovado National Park. Sitting by a pond, they'd observe the abundant red-eyed tree frogs with their lime-green bodies, orange toes, electric-blue thighs, yellow-striped flanks, and bulging, tomato-red eyes. In just one evening, each female would lay around a hundred eggs, which she'd encase in jelly and stick to leaves overhanging the water. But around half of the clutches were devoured by cat-eyed snakes. The others would hatch after six or seven days, releasing their tadpoles into the water—or, occasionally, onto Warkentin. "It was pretty common, in the field, to have tadpoles falling in your hair, tadpoles falling in your notebook," they tell me. "I also had the experience of bumping into a clutch and seeing a few embryos hatch out very quickly."

That was weird. The tadpoles weren't passively spilling out of eggs that Warkentin had broken. It looked like they were actively making a run for it. If they could do that when Warkentin bumped them, could they also flee from an attacking snake? Could they sense the motion of chewing jaws and decide to take their chances in the water? Warkentin presented this idea at a scientific meeting and was met with skepticism. Frog embryos were meant to be passive entities that hatch on a fixed schedule and are

oblivious to their environment. “Some people thought it was a crazy idea,” Warkentin says. “I thought it was a testable one.”

They collected batches of eggs and housed them in outdoor cages along with cat-eyed snakes. The snakes are nocturnal, so Warkentin had to check on them throughout the night. They’d sleep on a couch in an adjacent building, suffer through the clouds of mosquitoes, and wake up every 15 minutes to groggily inspect the eggs. It was rough, but they were right: Embryonic tadpoles can hatch early when attacked. Warkentin even saw them bursting out of eggs that were held in a snake’s mouth.

Warkentin has been studying this behavior ever since. Fortunately, their research now involves fewer itchy all-nighters and more infrared video cameras. They show me one recent video in which a cat-eyed snake lunges at a tree frog clutch and grabs several eggs in its jaws. As it tries to pull its mouthful free from the jelly, the surrounding embryos wriggle furiously, releasing an enzyme from their faces that quickly disintegrates their eggs. One of them plops into the water. A second later, another joins it. Soon, tadpoles are tumbling down too quickly to count, and the snake, still chewing its first mouthful, is left with a smear of empty jelly. “I never get tired of watching this,” Warkentin tells me.

Their experiments showed that frog embryos are neither as helpless nor as unaware as people thought. The embryos’ sensory bubble extends beyond the actual bubble in which they’re trapped. Light can pass through the translucent eggs, and chemicals can diffuse into them. But vibrations are what really matter. They pass into the eggs and into the embryos, which can distinguish between bad vibes and benign ones without any previous experience of

either. A bite from a snake will trigger hatching. Rain, wind, and footsteps will not. Even when a mild earthquake rattled Warkentin's pond, the embryos didn't react. By recording different vibrations and playing them back at the eggs, Warkentin showed that they're attuned to pitch and rhythm. Falling raindrops produce a steady pitter-patter of short, high-frequency vibrations. Attacking snakes produce lower frequencies and more complicated patterns, with prolonged bouts of chewing punctuated by periods of stillness. If Warkentin edited gaps of stillness into rainfall recordings to make them feel more snake-like, the tadpoles found them scarier and were more likely to hatch. They can clearly sense the world before entering it, and they can use that information to defend themselves. They have agency. They have an Umwelt.

"As they develop, they get more and more senses, and more and more information," says Warkentin. At two days old, the embryos can detect the oxygen levels around them, which tells them if their eggs have accidentally fallen into water. But they don't respond to snakes until they are just over four days old because, as Warkentin's student Julie Jung discovered, that's when the vibration sensors in their inner ears come online. They can escape from danger before then, but they have no way of sensing it.[*1] Snakes are not yet part of their Umwelt. But in a matter of hours, everything changes: A new sense kicks in, and a realm of vibrations to which they were once oblivious transforms their lives.

Once the tadpoles have transformed into frogs and are ready to make tadpoles of their own, males compete for access to mates. By watching them with infrared cameras, Warkentin and their colleague Michael Caldwell saw that males would square off along a branch, raise their bodies,

and vigorously shake their backsides. These displays are meant to be visually captivating, but males will also perform when their lines of sight are obscured. They might not be able to see each other, but they can still *feel* the vibrations created by their rival's quivering bum and use those vibrations to assess size and motivation. In these contests, the victors are usually those that shake for more time and create longer-lasting vibrations.[*2]

Many other animals probably communicate in this way. Male fiddler crabs attract mates by thumping their gigantic claws on the sand. Termite soldiers drum their heads against the walls of their mounds to create vibrational alarms that attract more soldiers. Water striders—insects that skate along the surface of ponds and lakes—can coerce partners into sex by making ripples that summon vibration-sensitive predators. All of these creatures create and respond to vibrations that travel along the surfaces around them, whether branch or beach. Scientists call these substrate-borne vibrations. Everyone else might just call them vibrations, or perhaps tremors or surface waves.[*3]

To some people, these surface vibrations (and the airflow patterns that excite wandering spiders and crickets) count as "sound." By that logic, everything I described in the second half of the previous chapter and everything I'm about to describe in this one falls within the rubric of "hearing." I have no horse in this race and don't care to pick one. If you're a lumper, feel free to read these as a single continuous chapter, and if you're a splitter, think of them as three discrete ones. Either way, it's worth noting that while these stimuli have a lot of overlaps, they do also have important differences in their physical properties that, in turn, determine which animals pay attention to them and what those species do with the information.

For example, airborne sounds are waves that oscillate in the direction of travel—imagine stretching and compressing a Slinky. Surface waves, by contrast, oscillate perpendicularly to the direction of travel—imagine shaking the Slinky up and down. Those oscillations are obvious as ripples on the surface of water. They also occur on solid ground to a less visible extent. Throw a rock on the ground, and a subtle wave will ripple along the surface. If an animal is sensitive enough, it could feel the rise and fall of the ground beneath its feet. Many animals *are* sensitive enough, but most humans are not. Aside from the bass of a speaker or the shake of a cellphone, most of us miss out on the lush vibrational landscape that other species are privy to. It doesn't help that surface vibrations can be hard to separate from airborne sounds. Animals often produce both at the same time, shaking earth and air simultaneously. And animals often detect both kinds of waves with the same receptors and organs, like hair cells and inner ears. We certainly talk about them using a shared vocabulary: Creatures are said to be "listening" for vibrations, even when those are inaudible.

Perhaps the most important distinction between surface vibrations and sounds is that the former are largely ignored, including by scientists who study the senses. For the longest time, researchers saw all kinds of drumming, thumping, shaking, and quivering body parts, and interpreted them as visual or auditory signals, while ignoring the surface waves that those movements produce. Every red-eyed tree frog cues into that sensory world from four and a half days of age, but generations of scientists ignored it. " We have encountered it, but we were not looking for it," wrote ecologist Peggy Hill. It's a lesson that sensory biologists, and everyone else, should heed: By

giving in to our preconceptions, we miss what might be right in front of us. And sometimes what we miss is breathtaking.

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I'M IN A lab in Columbia, Missouri, staring at a tick-trefoil plant. A dot of red light is shimmering on one of its leaves, as if someone planned to assassinate it. The dot is coming from a device called a laser vibrometer. It converts the vibrations moving over the surface of the leaf, which we cannot hear, into audible sounds, which we can. When I touch the table, I shake the entire plant and hear a loud roar. When I speak, the sound waves from my mouth set up surface waves in the leaf, which are converted back into sound waves by the speaker. I hear my own voice, as channeled through the plant. No one's interested in the sound of my voice, though. Rex Cocroft and his student Sabrina Michael are more interested in the song of the minute creature on the leaf. It's a treehopper—a kind of sap-sucking insect. It has large orange eyes, legs tucked so closely under its head that they resemble a beard, and black-and-white textures that look like a seashell. This species is known as *Tylopelta gibbera,* and though it has no official common name, Cocroft makes one up on the spot—the tick-trefoil treehopper.

We met Cocroft in the introduction, when he took his mentor Mike Ryan to meet some treehoppers in the Panamanian rainforest. That encounter took place more than 20 years ago, but Cocroft is still fascinated by these insects and the messages they exchange. By rapidly contracting muscles in their abdomen, they can create vibrations that move along the plants on which they stand,

and up the legs of other treehoppers. These vibrations are normally silent, but a vibrometer can convert them into audible sound. Cocroft, Michael, and I all lean in toward the tiny tick-trefoil treehopper with almost comical expectation. And then we hear a rumbling noise, which sounds entirely unlike what an insect would produce. It's a purr but a startlingly deep one, more lion than house cat.

"Here we go," says Cocroft, beaming.

"Good job, buddy," says Michael.

Plants are strong, flexible, and springy, which makes them fantastic carriers of surface waves.[*4] Insects exploit that property, filling plants with their vibrational songs. Between treehoppers, leafhoppers, cicadas, crickets, katydids, and more, Cocroft estimates that around 200,000 species of insects communicate through surface vibrations. Their songs aren't normally audible, and so most people are completely unaware that they exist. Those who become aware often get hooked.

Cocroft remembers his first time. He was a young student interested in animal communication and had decided to focus on treehoppers because they were obscure and understudied. In a field in Ithaca, he found a goldenrod plant that was covered in the species *Publilia concava*. He clipped a contact microphone onto the stem of the plant and listened through headphones. "Very shortly, I heard this *woo-woo-woo-woo,*" he tells me, mimicking a noise that sounds like a plaintive bullfrog. "It was a crazy sound that nobody had ever heard before, and it was right in my backyard. And that was it. I think that everyone who learns about this vibrational world can't help but be charmed by it, but there's a certain fraction of people who become so amazed that they have to go out and record from more species. There's so much out there. It's really endless."

Cocroft now has a library of treehopper recordings. When he plays them to me, I'm dumbfounded. The songs are haunting, mesmerizing, and surprising. None of them sound remotely like the familiar, high-pitched chirping of crickets or cicadas, but instead sound more like birds, apes, or even machinery and musical instruments. They're often deep and melodic, and they likely sound that way to the insects themselves. The song of *Stictocephala lutea* resembles a scratchy didgeridoo. *Cyrtolobus gramatanus* melds a hooting monkey with mechanical clicks. *Atymna* sounds like the warning that a truck makes when it's backing up, combined with a drum. *Potnia* lures me into a false sense of security with a mundane *brum-brum-brum* train, which then ends with a shocking half moo, half scream. When Cocroft first heard that, he tells me, "I sat back in my chair and thought: No way! *Is that an insect?*"

These vibrational songs are so strange because they're not subject to the same physical constraints as airborne sounds. In the air, an animal's pitch is normally tied to its size, which is why mice don't bellow and elephants don't squeak. That constraint doesn't exist for surface waves, so small animals can make low-frequency vibrations that seem like they're coming from much larger bodies. A treehopper can produce a mating call that's as low as that of an alligator, even though the latter is millions of times heavier.

Airborne sounds have another limitation: They radiate outward in three dimensions, and so lose energy very quickly. Insects compensate for this by concentrating all their efforts in a narrow range of frequencies, producing simple chirps. But surface waves only have to travel along flat paths, so they retain their energy over longer distances. Insects that signal along this channel can afford to get more creative. They can produce melodic upsweeps

and downsweeps, stacks of tones, and percussive backdrops. That's why they sound more like birds.

There are more than 3,000 species of treehoppers, and they use surface waves in a variety of ways.[*5] Some babies produce synchronized vibrations to summon their mothers when they sense a predator. Some mothers produce vibrations that silence the youngsters, lest their panicked tremors attract even more predators. Tick-trefoil treehoppers, like the one I saw in Cocroft's lab, use surface waves to congregate in groups. One will purr, and if another is within legshot, it responds with a sharp tick. The duo repeatedly move toward each other while purring and ticking, like children shouting "Marco" and "Polo" until finally they meet. They court each other in a similar way. A male makes a vibratory whine, followed by a train of high-pitched pulses. If a female hears him and is receptive, she makes a hum as soon as he finishes. He uses that hum to gauge her direction, walks a little closer, and makes another whine. She hums again, and slowly, the two duetters find each other. But if a second male is on the same plant, he'll unleash his own whine in the final moments of the first male's call; this shuts down the female's response. The first male retaliates by timing his next call to interrupt the second male, and the two go back and forth, repeatedly jamming each other. "If there's more than one male, it takes them a long time to find a female," Cocroft says.[*6]

Treehoppers can gather on a single plant in the hundreds, and many of them might be vibrating away at the same time. A single stem might be as raucous as a busy street, full of cries for help, calls for silence, invitations to hang out, and literal booty calls. Even if you've never heard of treehoppers until now, if you spend any time outdoors,

you will almost certainly have sat next to one, oblivious to the vibrational serenade it was performing. And these are just some of the many animals taking part in the full vibrational chorus. Masked birch caterpillars scrape their anuses on leaves to invite other caterpillars to social gatherings. Acacia ants vigorously defend their home trees from browsing mammals if they sense the vibrations created by chewing mouths. Even species whose calls we can hear are often sending vibrational signals that we can't. Cocroft plays me more recordings, made through plant stems, in which chirping cicadas sound like cows, and katydids sound like revving chainsaws. "I'm just amazed at the unbelievable richness of nature that already seemed so rich," he says.

It is surprisingly easy to tap into that extra richness, even without a laser vibrometer. In 1949, three decades before such instruments were invented, a pioneering Swedish entomologist named Frej Ossiannilsson heard the vibrations of leafhoppers by putting them on grass blades, sticking the blades in test tubes, and holding the tubes to his ear. As a trained violinist, he transcribed what he heard in musical notation. To hear them today, Cocroft simply uses a cheap speaker and a digital recorder connected to a clip-on microphone that a guitarist might use. With this kit, he spends his spare time prospecting for vibrations, miking random stems, leaves, and branches in nearby parks, or even in his backyard. Most times, he'll hear something new. I ask him to show me.

We drive to a park just a few minutes away from his lab. In a sunny spot, next to a wall of long grass, Cocroft and his students kneel down and begin clipping their microphones onto plants. For a while, we hear nothing. It's late September, and the season for vibrational song is drawing

to a close. Strong gusts of wind are drowning everything else out. I can hear the footsteps of a walking caterpillar, and a beetle landing heavily on a leaf, but nothing like the haunting melodies I had hoped to experience firsthand. After a disappointing half hour, Cocroft apologizes. But just as we decide to call it a day, one of his students, Brandy Williams, calls to us. “There’s something really cool here,” she says.

We walk over, and from her speaker, we hear what sounds like…sniggering? “Eh, eh, eh, eh, eh,” it seems to say. It is more hyena-like than insect-like. “Eh, eh, eh, eh, eh.” Williams has clipped her microphone onto the bottom of a random blade of grass, and we cannot see any insects upon it. And yet, there’s definitely an insect there. “Eh, eh, eh, eh, eh.” So few people have listened to the vibrational world of treehoppers and other insects that on any attempt, there’s always a chance of experiencing something that no other human ever has. I ask Cocroft if he’s heard the mysterious sniggering before. “I’ve heard things *like* that,” he tells me, “but whether I’ve heard that one…I really don’t know. There are so many species out there.”

Satisfied, we head back to his car. I’m suddenly aware of the choruses that might be vibrating through all the plants we walk past. I think about the vibrations that we ourselves are making with every step—the seismic surface waves that ripple out from each footfall. Although we hear the crunch of twigs underfoot and the soft squelches as shoes meet mud, we don’t detect the tremors our footsteps send out. But other creatures do.

—

AS NIGHT FALLS on the Mojave Desert, so does silence. Aside from the occasional howl of a coyote or the distant roar of a passing plane, the air is silent. The dunes, however, thrum with vibrations. As insects emerge to forage, their petite feet create tremors that course along the sand. These waves are extremely faint and short-lived. But they're strong enough for the sand scorpion to sense.

Sand scorpions are some of the Mojave's most common residents and will eat anything they can successfully grab and sting, including other sand scorpions. In the 1970s, Philip Brownell and Roger Farley realized that the scorpions would readily attack anything that walks or lands within 20 inches of them. " Gentle disturbances of the sand with a twig also triggered a vigorous attack," Brownell later wrote in *Scientific American,* "but a moth held squirming in the air a few centimeters from the scorpion did not attract its attention." It seemed to track its prey using surface waves.

Brownell and Farley tested this idea by placing scorpions in a cunningly designed arena. It looked smooth and continuous on the surface, but a buried air gap blocked vibrations from traveling between the two halves. If a scorpion stood on one half, it was completely oblivious when the researchers prodded the other half with a stick, even at a point just an inch away. But if even one of the scorpion's legs straddled the gap, it became aware of the entire arena and would turn to face any disturbance.

Its sensors lie in its feet. On the joint that could be loosely described as an "ankle," there's a cluster of eight slits, as if the exoskeleton had been scored by a sharp knife. These are the slit sensilla—vibration-detecting organs common to all arachnids. Each slit is spanned by a membrane and connected to a nerve cell. When a surface

wave reaches the scorpion, the rising sand pushes against its feet. This compresses the slits by an infinitesimal amount, but enough to squeeze the membrane and cause the nerves to fire. By sensing the tiniest changes in its own exoskeleton, the scorpion can feel the steps of passing prey.

The first time this happens, it shifts into its hunting stance. It raises its body, opens its pincers, and arranges its eight feet into a near-perfect circle. In this position, it can work out where surfaces waves are coming from by noting when those waves hit each of its feet. It turns and runs before pausing and waiting for another wave. When one arrives, it turns and runs again, getting closer to its target with each successive tremor. If its pincers collide with something, the scorpion seizes and stings. If it arrives at the source of the waves and can't find anything, it knows that its prey is underground, and digs it out.

Fittingly, these discoveries were earthshaking. They were made over a decade before Karen Warkentin found their frog-filled pond and Rex Cocroft started listening to treehoppers. At the time, the study of surface vibrations was even more niche than it is now. Scientists knew that animals can feel such vibrations, but few believed they could track down a source, any more than a human can locate an earthquake's epicenter without equipment.[*7] It seemed especially preposterous that an animal could do so on sand, whose loose grains ought to damp and absorb vibrations rather than transmit them. But Brownell and Farley's meticulous experiments showed that these assumptions were wrong. Sand, soil, and solid earth are surprisingly good at transmitting surface waves, which are strong enough for animals to detect and informative enough for them to use. They were also interesting enough

for scientists to study. Others began to look for seismic senses in other animals. They didn't have to look very far.

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THE LARVAE OF antlion insects, which are known as doodlebugs in North America, also hunt using surface waves that travel along sand. But rather than running down their victims, they bring their prey to them. They dig conical pits in dry sand and lurk at the bottom with their plump bodies buried and their gigantic jaws agape. The pits are precisely constructed traps. Their sides are shallow enough that they don't spontaneously collapse, but steep enough that any ant that walks into them will start to slip. The footfalls of an ant, even a struggling one, are hardly heavy, but the antlion is covered in bristles that can detect vibrations of less than a nanometer. It can sense when an ant is walking outside the pit, and can definitely tell when one is inside it. It reacts by tossing sand at the thrashing creature, creating an avalanche that further destabilizes the already slippery ground beneath it. Eventually the ant falls into the antlion's jaws, and is pulled under and injected with venom. Its vibrations then cease.

Other predators hunt by exploiting the seismic senses of their prey. Every April, the town of Sopchoppy, Florida, hosts a festival to celebrate the old tradition of worm grunting. Since the 1960s, several local families have ventured into the woods, pounded stakes into the ground, and created strong vibrations by scraping the stakes with iron. Soon, hundreds of large earthworms rise up, where they are easily collected by the bucketful and sold as bait. Some worm grunters believe that their vibrations mimic the sound of rainfall. Ken Catania—the same man who

studied the star-nosed mole—proved otherwise. While attending the Sopchoppy Worm Gruntin' Festival in 2008, he showed that worms barely react to the patter of raindrops, but they hightail it to the surface if they detect the vibrations of a digging mole, or even a recording of those vibrations. This is usually a sensible strategy since moles don't pursue their prey aboveground. But several surface predators have learned that they can summon worms by deliberately shaking the ground. Herring gulls and wood turtles do this, as, apparently, do Floridians. For decades, worm grunters have been unknowingly mimicking mole-quakes.[*8]

Animals have likely been able to sense seismic vibrations from the moment they ventured onto the land from the oceans. The first backboned creatures to make that move—early amphibians and reptiles—probably laid their large heads on the ground, allowing surface waves to travel through the bones of their jaws and into their inner ears. In the ancestors of mammals, three of those jawbones became repurposed for transmitting airborne sounds. They shrank and moved, turning into the small bones of the middle ear—the hammer, anvil, and stirrup. Now, instead of transmitting surface vibrations from the ground via the jaw, they transmit sounds from the air via the outer ear and eardrum.

But the ancient bone-conduction pathway still works: Vibrations can pass directly to the inner ear via the bones of the skull, bypassing the outer ear and eardrum altogether. Cyclists and runners can use bone-conduction headphones to listen to music while keeping their ears free. People with hearing difficulties can use bone-conduction hearing aids, while deaf dancers can use special vibrating dancefloors. And everyone who can hear does so partly

through bone conduction, which is why people often think they sound strange on recordings. Those recordings reproduce the airborne components of our voices, but not the vibrations traveling through our skulls.

Other mammals have tweaked their own anatomy to better sense vibrations through bone conduction and restore their ancestral seismic sense. Among the sands of southwestern Africa lives the Namib Desert golden mole. It is mostly insensitive to airborne sounds, because its outer ear is tiny and hidden in fur. But it is highly sensitive to vibrations, thanks to its malleus—the hammer bone of its middle ear. This bone is relatively enormous: Even though the golden mole weighs just an ounce and would fit in your palm, its malleus is bigger than yours.[*9]

The golden mole forages at night, either by trundling over the Namib's dunes or by "swimming" through the loose sand with its paddle-like feet. It searches for sparse mounds of dune grass, where delicious termites might nest. Peter Narins has suggested that wind blowing over these mounds produces gentle low-frequency vibrations through the dunes, which the golden mole can detect by periodically dipping its head and shoulders into the sand. Every time it does, vibrations pass into its inner ear via its malleus, and humming beacons of dune grass resound around it.[*10] The golden mole's seismic sense is so acute that, though blind, it can walk between distant mounds in virtually straight lines.

Golden moles, sand scorpions, antlions, and earthworms all have poor eyesight and all live either very close to the ground or within it. It seems plausible, and perhaps even obvious with hindsight, that they should be attuned to vibrations in the ground. But a seismic sense is harder to intuit in creatures that stand higher off the ground. Cats,

for example, have a lot of vibration-sensitive mechanoreceptors in the muscles of their bellies. When a cat crouches down during a stalk, is it doing more than lying low? Is it also sensing the vibrations of potential prey? Could a lion pinpoint distant antelope herds? “ The lying about that nature documentaries attribute to innate laziness of lions may actually be a period of astute assessment,” wrote Peggy Hill in her book about vibrational communication. Hill herself admits that such ideas could be “greeted with applause or derision,” but her point is that the questions are worth asking. Seismic senses have been long neglected, and biologists always seem to be one stray observation away from uncovering an unseen side to even the most familiar creatures.

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IN THE EARLY 1990s, Caitlin O’Connell spent weeks at a time sitting in a dank, cramped, half-buried cement bunker, gazing through a narrow slit at a waterhole. She had come to Etosha National Park in Namibia to study elephants and to find ways of keeping them away from croplands. In the meditative confines of her bunker, she got to know the local herds, and certain behaviors began to leap out. Sometimes, she noticed, an elephant seemed to sense something in the distance, freeze midstride, and lean forward with a foot propped up on its toenails. To O’Connell, that pose seemed strangely familiar. As a master’s student, she had studied the vibrational communication of planthoppers, which are related to treehoppers, and which also lean forward and press down on their feet when trying to detect each other’s signals. Could the elephants really be doing the same? It surely wasn’t a coincidence that whenever one of them

adopted this pose, other elephants soon appeared in the distance. The animals seemed to be listening with their feet, but no one seemed to have noticed.

In 2002, O'Connell returned to her waterhole to test her idea. She had previously recorded the alarm call of local elephants that were being threatened by lions. The original call was audible, but O'Connell transformed it into a mostly seismic signal by cutting off the higher frequencies and playing it through shakers buried in the ground. When she did this, entire herds would freeze. They'd fall silent, become wary, and bunch up into defensive formations. Watching them through night-vision goggles, O'Connell was thrilled. " All these years of planning, hoping, and dreaming of this moment. We were finally showing that my original hunch so long ago was true," she wrote in her book *The Elephant's Secret Sense.* "Elephants were detecting and responding to our seismic cues."

A few years later, she repeated the experiment, but with an extra anti-predator rumble recorded in Kenya. This time, the Etosha elephants responded to the vibrations of the familiar local alarm, but not to the unfamiliar Kenyan one. They not only paid attention to vibrations but could tell if they were coming from elephants they knew. More recently, O'Connell has shown that elephants can respond to other kinds of seismic signals. In one video, a sexually active bull named Beckham searches fruitlessly for a fertile female after hearing her rumbles through a hidden speaker.[*11]

What of the other elephant-like creatures, like mammoths and mastodons, that used to roam the planet? What about the giant ground sloths, the short-faced bears that would have towered over modern grizzlies, the armadillos the size of cars, or the hornless rhinos that were 10 times heavier than modern ones? These megafauna are

now all extinct, and humans and our prehistoric relatives are to blame. As we spread around the globe, the biggest animals blinked out. That trend continues today. The three remaining species of elephants—two in Africa and one in Asia—are all endangered. The next-biggest land animals—white and black rhinos, giraffes, and hippos—are in trouble, too. Great herds are also diminished. Between 30 and 60 million bison once roamed North America in groups that were thousands strong, but European colonists slaughtered them in a bid to also exterminate the Indigenous peoples who depended on them. Now just 500,000 bison remain, and most are confined to private lands. Imagine how much quieter the ground is now without all those hooves and paws. Six continents that once would have thundered with the footsteps of titans now reverberate with sparse gurgles.

Can humans, the cause of that seismic silencing, even feel the loss? Western societies have largely cut themselves off from the ground beneath their feet with shoes, seats, and floors. If they spent more time sitting upon instead of standing above the ground, what might they sense? Luther Standing Bear, an Oglala Lakota chief and author, offered a clue. “ The Lakota…loved the earth and all things of the earth, the attachment growing with age,” he wrote in 1933. “The old people came literally to love the soil, and they sat or reclined on the ground with a feeling of being close to a mothering power.… This is why the old Indian still sits upon the earth instead of propping himself up and away from its life giving forces. For him, to sit or lie upon the ground is to be able to think more deeply and to feel more keenly; he can see more clearly into the mysteries of life and come closer in kinship to other lives about him. The earth was full of sounds which the old-time Indian could

hear, sometimes putting his ear to it so as to hear more clearly."

That direct connection to the natural vibratory world may be in decline, but a different vibroscape has arisen. Modern cellphones buzz against our skin and fingertips, alerting us of breaking news, upcoming events, and social attention. Our devices use vibrations to connect us to the world beyond our bodies, extending our Umwelt beyond the reach of our anatomy. As usual, though, another group of animals got there first.

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"IT IS PRETTY gross in here, just to warn you," Beth Mortimer warns me. And yet, I am unprepared.

I had asked to see her colony of *Nephila* spiders, which I assumed would be housed individually in a row of cages. Instead, we walk through a heavy door and a curtain of wide plastic slats into a large room that used to be an aviary but now houses a few dozen free-range spiders. Mortimer and I stand in the middle of this arachnarium to avoid blundering into the messy, meter-wide webs. They are hard to see, but I can easily sense where they are by looking for the large spiders at their centers. Each is the size of an ear. In the wild, *Nephila* webs can be big and strong enough to catch bats. In this room, they are fed on flies, which are also allowed to roam freely. That's the gross bit: The flies are bred from a compost bin in the corner, full of rotting bananas and milk powder. As Mortimer tells me about this, and about her work on spider silk, I try to ignore the large blowflies landing on my hair, notepad, and pen. "I bring undergrads in here and they're disappointingly squeamish," she says.

To humans, whose eyes can scan the entire scene and are sharp enough to just about make out the silk of the webs, the room is a labyrinth of death traps waiting to ensnare the flies. To the spiders, which have very poor eyesight, the room doesn't really exist: There is only the web, and whatever vibrates it. To the flies, the thin webs are imperceptible until they are ensnared in one. I almost feel sorry for them. "I don't," says Mortimer. "I hate flies." She adores spiders, though, and *Nephila* most of all. She studies other vibration-sensing animals, including water striders, planthoppers, and elephants. But *Nephila,* the first creatures she worked with when she started her scientific career, "will always be my first love," she says. "I really respect the elephants. But I *love* the spiders. The fact that they're so misunderstood by so many people just really makes me want to sing their praises so much more."[*12]

Spiders have been around for almost 400 million years, and they've likely been producing silk for all that time. Their silk is a marvel of engineering. Though light and elastic, it can be stronger than steel and tougher than Kevlar. Spiders use it to wrap their eggs, construct shelters, hang in the air, and soar through the skies (more on that later). Most famously, many species fashion it into a flat, circular shape—the orb web.

The orb web is a trap, which intercepts and immobilizes flying insects. It's also a surveillance system, which extends the range of the spider's senses well beyond the reach of its body. That body is covered in thousands of slit sensilla—vibration-sensing cracks similar to those that sand scorpions use to detect the seismic activity of their prey. On spiders, these slits are also concentrated around the joints, where they're grouped into clusters called lyriform organs. Using these exquisitely sensitive organs, all spiders can

sense the vibrations coursing through whatever they're standing upon. For the tiger wandering spider of the previous chapter, that surface is the ground. For orb-weavers like *Nephila,* it's the web. These spiders construct the surfaces that they then sense vibrations through. For that reason, the orb web isn't just another substrate, like soil, sand, or plant stems. It is built by the spider and it is part of the spider. It is as much a part of the creature's sensory system as the slits on its body.

Like the *Nephila* in Mortimer's arachnarium, most orb-weavers sit in the middle of their webs and rest their legs on the radial spokes that funnel vibrations toward them. From this position, they can distinguish the vibrations generated by rustling wind or falling leaves from those created by struggling prey. They can probably work out where those struggles are coming from by comparing the strength of the vibrations hitting each of their legs. They can assess the size of their prisoners, and will approach the larger ones more carefully or not at all. If the prey stops moving, they can find it by deliberately plucking the silk and "listening" to the returning vibrational echoes. When it comes to capturing prey, vibrations supersede other stimuli. If a tasty fly buzzes above an orb-weaver, the spider will simply wave it away with its legs. The fly only becomes recognizable as food if it shakes the web.

This dependency on vibrations is so absolute that many animals can exploit orb-weavers by camouflaging their footsteps. The small dewdrop spider *Argyrodes* is a thief, stealing from larger spiders like *Nephila* by hacking their webs. From a nearby hiding place, it runs several lines of silk over to the hub and spokes of a *Nephila* web, effectively plugging its sensory system into that of the bigger spider. It can tell when *Nephila* has caught

something and is wrapping it in silk for storage. It then runs over and eats the insect itself, often after cutting it free from the main web so that the host spider can no longer detect it. *Argyrodes* acts carefully to avoid creating its own telltale vibrations. It runs only when *Nephila* is moving and treads more slowly when *Nephila* is still. It also holds on to any strands it cuts to avoid any sudden releases in tension. Through such subterfuge, this thief is almost never caught. As many as 40 of them might be plugged into a single *Nephila* web.

Other creatures have more lethal intentions than pillaging food. Some assassin bugs walk so stealthily that they can creep right up to a spider and kill it on its own web. *Portia,* a jumping spider that eats other spiders, will violently twang a web to mimic the impact of a twig and use this vibrational smoke screen to charge at its prey. Both *Portia* and the assassin bugs can pluck webs to mimic the vibrations of ensnared prey and lure spiders to them. These predators are all visually conspicuous, but as long as their vibrations feel like those of an insect, a twig, or a breeze, an orb-weaver can’t tell the difference. It lives in what Friedrich Barth calls “ a small woven world full of vibrations.”

An orb-weaver not only builds its own vibrational landscape but also can adjust it as if tuning a musical instrument. The range of that instrument is immense. By using gas guns to fire projectiles at individual silk fibers and analyzing the threads with high-speed cameras and lasers, Mortimer concluded that some silks can transmit vibrations over a wider range of speeds than any known material. A spider can theoretically change the speed and strength of those vibrations by altering the stiffness of its silk, the tension in the strands, and the overall shape of the

web. It can do this every time it builds a new web, by pulling silk out of its body at different speeds, by creating fibers of different thicknesses, or by adding tension to the new strands. It can adjust webs that have already been spun by adding, removing, or tugging on specific threads. It can rely on silk's natural tendency to contract in humidity, and then stretch out these tightened threads to just the right degree. It's not clear when orb-weavers might decide to do any of this, but they certainly have the option of tuning their own senses and defining their own Umwelt according to their needs.

Zoologist Takeshi Watanabe showed that the Japanese orb-weaver *Oclonoba sybotides* changes the structure of its web when it is hungry. It adds spiral decorations that increase the tension along the spokes, improving the web's ability to transmit the weaker vibrations transmitted by smaller prey. When it is famished, every morsel counts. To capture such morsels, the spider expands the range of its senses by changing the nature of its web.

But here's the truly important part: Watanabe found that a well-fed spider will *also* go after small flies if it is placed onto a tense web built by a hungry spider. The spider has effectively outsourced the decision about which prey to attack *to its web*. The choice depends not just on its neurons, hormones, or anything else inside its body, but also on something outside it—something it can create and adjust. Even before vibrations are detected by its lyriform organs, the web determines which vibrations will arrive at the leg. The spider will eat whatever it's aware of, and it sets the bounds of its awareness—the extent of its Umwelt—by spinning different kinds of webs.[*13] The web, then, is not just an extension of a spider's senses but an extension

of its *cognition*. In a very real way, the spider thinks with its web. Tuning the silk is like tuning its own mind.

A spider can also tune its body. Biophysicist Natasha Mhatre showed that the infamous black widow can adjust the lyriform organs on its joints to different vibrational frequencies by changing its posture. The widow spins a messy horizontal web, and normally hangs upside down from it with legs outstretched. But when it's hungry, it can also draw its legs into a "crouch"—a sensory power pose that retunes its joints to higher frequencies. Like the tense web of Watanabe's orb-weaver, this stance might shift the spider's Umwelt toward the movements of smaller prey. It might also help it to ignore the low frequencies of wind. It's like a postural squint, which allows the spider to focus its attention. The analogy isn't exact, though, since squinting helps us to focus on particular parts of space. Here, the black widow's posture focuses on different parts of *information space*. It's as if a human could emphasize the red parts of our vision by squatting, or single out high-pitched sounds by going into downward dog.

The black widow's crouch reminds me of the hunting stance of the sand scorpion, the dipped head of the golden mole, and the forward-leaning, tipped-toe posture that clued Caitlin O'Connell in to the seismic sense of elephants. It seems only right that animals that parse the vibrations moving beneath them might have special ways of interacting with whatever they're standing on. For us, sitting down will suffice.

Since getting a puppy, I've been spending a lot more time on the floor than I used to. From that position, I can feel surface vibrations that I hadn't ever noticed before. I can feel the footsteps of my neighbors as they come in and out. I can feel the rumbles of garbage trucks as they drive

past outside. This is a world I can lower myself upon, but it's one that Typo always resides in. Being a corgi, he is usually five feet closer to the rippling ground. I wonder what he feels. I also wonder what he hears. Typo will often perk up from a rest, his Yoda-esque ears picking up something that mine did not. He reminds me of what I'm missing: not just the surface waves traveling through the floor below us but also the pressure waves—sounds—moving through the air around us.

SKIP NOTES

*1 When the tadpoles' bodies are shaken, small crystals in their inner ears push against touch-sensitive hair cells, which send signals to their brains. This same inner ear system also controls a reflex that steadies the tadpoles' gaze by moving their eyes in the opposite direction to their head. So Jung built a jury-rigged tadpole rotator. By placing the tadpoles in tubes, gently turning them, and watching if their eyes swiveled, she could work out exactly when their inner ears become sensitive to vibrations.

*2 Caldwell even provoked males with a model frog mounted on an electric shaker. When this Robofrog vibrated, other males responded with their own aggressive signals. When it made visual signals without accompanying vibrations, the other males didn't care.

*3 The vocabulary gets a little difficult, even for scientists. Many of them use *vibrations* in a colloquial way to specifically refer to substrate-borne vibrations, even though the term technically also encompasses sounds. I'm going to do the same here, with apologies to engineers who are now surely recoiling in disgust.

*4 "Surface waves" isn't strictly accurate here. When a wave travels along a long, thin structure, like a plant stem or a strand of spider silk, it's not that the surface ripples. Instead, the structure itself bends and flexes, which is properly known as a bending wave. I have relegated this to a note so that we aren't drowning in terms.

*5 Cocroft often tries to work out what different vibrations are for by recording them, playing them back to the treehoppers, and seeing how the insects react to the artificial noises. His sister once told a friend about this, and the friend said, “He lies to bugs?”

*6 Many duetting insects will jam each other’s signals, and scientists can exploit this behavior to control agricultural pests. By playing the right vibrations along wires that run through vineyards, they can shut down the sex lives of leafhoppers that spread diseases.

*7 Can animals sense earthquakes before they happen? It seems likely that many species could detect the incoming seismic waves, but whether they can parse that information and take appropriate evasive action is unclear. For millennia, there have been many anecdotal reports of creatures acting strangely before a quake, but such behaviors aren’t consistent, and it’s hard to know if human observers are simply remembering unusual activity in hindsight. In a few cases where elephants and other animals had been coincidentally fitted with tracking collars before an earthquake struck, they didn’t seem to move any differently in the period before the shaking began.

*8 In 1881, Charles Darwin wrote that “ if the ground is beaten or otherwise made to tremble, worms believe that they are pursued by a mole and leave their burrows.” Over a century later, Catania confirmed his statement.

*9 Golden moles, despite their name and appearance, are not moles. They independently evolved the same physique and lifestyle, but they’re more closely related to a motley menagerie of mammals that includes manatees, aardvarks, and elephants.

*10 The malleus normally picks up sound vibrations from the eardrum, and moves to transmit them to the incus (anvil). The golden mole’s version is so big that it works in a slightly different way. When seismic waves reach the mole’s head, the malleus mostly stays in the same place, and the rest of the skull, including the incus, vibrates around it.

*11 As we saw in Chapter 1, doing experiments with animals as big, powerful, and intelligent as elephants is not easy, and their seismic sense remains largely mysterious. O’Connell has shown that elephants produce surface waves when they call and walk, but do they do so deliberately, or are such waves incidental? The vibrations can travel over several miles, and elephants could potentially use them to coordinate their social groups over long distances—but do they? Can they use that information to tell which elephants

are nearby, or whether they are distressed or aggressive? Seismic signals are likely part of their Umwelt, but it's not yet clear if they're an important part.

*12 It's striking to me that many scientists who study vibrational senses are also musicians. Frej Ossiannilsson, who pioneered the field, was a violinist. Rex Cocroft was originally going to major in piano before he was seduced by biology. Beth Mortimer is a singer who also plays the French horn and piano.

*13 Orb-weavers will also pull on spokes that lead to areas where prey are repeatedly caught, focusing their attention on parts of the web most likely to yield food.

8.

All Ears

Sound

ROGER PAYNE USED TO BE scared of the dark. While in high school, he tried to overcome that phobia by going on long nighttime walks through a nature reserve near his home. During these solitary strolls, he often heard (and occasionally saw) an owl that lived in a nearby building. And as his fear of the night subsided, his interest in owls grew. In 1956, when he got a chance to study the birds as an undergraduate student, he leapt at it.

Owls have large eyes, but they can catch prey in darkness so total that even they can't see. Payne suspected that they used their ears. To test this idea, he taped black plastic sheets over the windows of a large garage and carpeted the floor with a thick layer of dry leaves. On a perch in the corner, he placed a hand-raised barn owl, who was named Wol after the character from *Winnie-the-Pooh*. Then, sitting in the dark, Payne released a mouse. "I couldn't see anything, but once the mouse started moving, I could hear the sounds of rustling," he tells me. So could Wol. For the first three nights of the experiment, the bird did nothing. But on the fourth night, Payne heard the sound of a strike. He flicked on the lights and saw Wol with the mouse in his talons.

Over the next four years, Payne did more experiments with Wol and other barn owls, all of which confirmed how adept they are at finding their prey through sound. The mice seemed aware of the danger, and would skulk at a

glacial pace when Payne introduced them into a leaf-strewn room. As soon as they started rustling, they were done for. Watching through an infrared scope, Payne saw that owls would react to the first rustle by leaning far forward. On the second, they would swoop headfirst toward the rodent and, at the last moment, rotate their body by almost 180 degrees to place their talons where their faces had been. They were so accurate that they could not only land on a mouse but strike it along the long axis of its body. If Payne dragged a mouse-sized wad of paper through the leaves, the owls struck that, too. If he tied a single leaf to the tail of a mouse and allowed it to scamper over a foam floor, the owls attacked the leaf. These tests confirmed that the birds couldn't be using smell, vision, or any other sense. They were unquestionably using their ears to guide their strikes. And if Payne plugged one of those ears with cotton, the once-unerring birds would miss their rodents by more than a foot. "It was a thrill," he tells me. "The evidence was so clear."

If a mouse rustles, a dog barks, or a tree falls in a forest, it produces waves of pressure that radiate outward. As these waves travel, the air molecules in their path repeatedly bunch up and spread out. These movements, which occur in the same direction as the wave's line of travel, are what we call sound. The number of times the molecules compress and disperse in a second determines the sound's frequency—its pitch, which is measured in hertz (Hz). The extent to which they move determines the sound's amplitude—its loudness, which is measured in decibels (dB). Hearing is the sense that detects those movements.

Your ear consists of three parts—the outer, middle, and inner ears. Your outer ear greets incoming sound waves,

collecting them with a fleshy flap and sending them down the ear canal. At the end of the canal, they vibrate a thin, taut membrane called the eardrum. Those vibrations are amplified by the three small bones of the middle ear, which we met in the last chapter, and transmitted to the inner ear—specifically, into a long fluid-filled tube called the cochlea. There, the vibrations are finally detected by a strip of movement-sensitive hair cells, which send signals to the brain. A sound is heard.[*1]

The barn owl's ear shares the same basic structure: The outer ear collects, the middle ear amplifies and transmits, and the inner ear detects. But while your outer ears are a pair of fleshy flaps, the owl's are effectively its entire face.[*2] The feathers of the conspicuous facial disc that makes owls look owlish are thick, stiff, and densely packed. They act like a radar dish that collects incoming sound waves and funnels them toward the ear holes. These enormous openings are found behind the owl's eyes, hidden among its feathers. In some species, they're so wide that if you part the overlying feathers and look into the ears, you can see the back of the owl's eyeball. These features, combined with an eardrum and a cochlea that are much bigger than you'd expect for a bird of its size, contribute to the exceptional sensitivity of a barn owl's hearing.

The owl excels not only at detecting sounds but also at working out exactly where they're coming from.[*3] As we saw in the chapter on vision, if you make a thumbs-up sign with your arm outstretched, your nail represents roughly one degree of space. Masakazu Konishi and Eric Knudsen showed that at best, barn owls can localize a sound's source to within 2 degrees. That's better than most land-living animals. For comparison, cats, whose ears are

roughly as sensitive as a barn owl's, can only localize sounds to within 3 to 5 degrees.

Humans are almost as good as owls in the horizontal direction, but considerably worse in the vertical, where our accuracy falls to between 3 and 6 degrees. That's because our ears are level with each other, so sounds hit both at roughly the same time whether they're coming from above or below.[*4] An owl's ears, however, are uniquely asymmetric, with the left being higher than the right. If you think of an owl's face as a clock, its left ear opens at two o'clock and its right ear at eight o'clock. If a sound comes from above *or* from the left, it arrives a little sooner and a little more loudly at the higher left ear than the lower right one. If the sound comes from below or from the right, the opposite is true. The owl's brain uses these differences in timing and loudness to work out the position of a sound's source in both the vertical and horizontal. If I go on a hike and hear a rustling noise nearby, I can tell roughly where it's coming from, and I turn my head so that my eyes can spot the source. But an owl perched overhead can tell *exactly* where the noise is coming from with its ears alone. A great gray owl can pluck a lemming from within its snow-covered tunnel or accurately bust through the roof of a gopher burrow, solely by listening to the chewing or scurrying sounds coming from beneath the ground. These feats are remarkable, and they hint at why hearing can be such a useful sense.

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AMONG THE TRADITIONAL five senses, hearing is most closely related to touch. That might be counterintuitive, since the latter is concerned with surfaces, which are solid and

tangible, and the former deals with sounds, which seem airborne and ethereal. But both hearing and touch are mechanical senses, which detect movements in the outside world using receptors that send electrical signals when they're bent, pressed, or deflected. In touch, those movements occur when fingertips (or whiskers, bill tips, and Eimer's organs) are pressed or stroked against a surface. In hearing, the movements occur when sound waves reach the ear and deflect small hair cells within it.

But unlike touch, hearing can operate over long distances. Unlike vision, hearing functions in darkness and through solid, opaque barriers. Unlike the vibrational sense from the previous chapter, hearing doesn't need a surface and can work through all-encompassing media like air or water. And unlike smell, which is limited by the slow diffusion of molecules, hearing works at the considerably faster speed of sound. Some senses have a few of these qualities, but hearing has them all, which is why some animals rely so heavily upon it. William Stebbins once encapsulated this beautifully: "Very different from other forms of stimulation, [sound] can impart information on current events at an unseen distance," he wrote.

Compare an owl to a rattlesnake. Both are nocturnal. Both hunt rodents. The rattlesnake doesn't need to eat very often and is an ambush hunter. It can use its sense of smell to find the right spot for a lengthy stakeout, and wait for victims to run within the short range of its infrared sense. The owl has no such luxury. To sustain its high metabolism, it must find prey more regularly, which means scanning a wide swath of forest and accurately localizing the rustles of fast-moving but unseen rodents. Hearing—long in range, fast in speed, and precise in resolution—is naturally its primary sense.

But hunting by sound has one major disadvantage—interference. A visually guided predator like an eagle doesn't emit light when it moves, but an owl can't help but make noise with its own wingbeats. Those noises, which are close to the owl's ears, could potentially drown out the faint and distant sounds of its prey. Fortunately, the owl has soft feathers on its body and serrated edges on its wings that make its flight almost imperceptibly quiet. The noise it does make is mostly below the range to which its ears are most sensitive and below the lower limit of what small rodents can hear. The owl can hear a mouse just fine, but a mouse can barely hear an owl coming.

Kangaroo rats can. These little hopping rodents have relatively huge middle ears, which are larger than their brains. These chambers specifically amplify the low frequencies produced by an owl's wings and allow kangaroo rats to hear incoming danger that most other rodents can't perceive. So they're especially difficult for barn owls to catch. They can even hear the sounds that rattlesnakes make when they strike, with enough time to jump away, turn in midair, and kick the lunging snakes in the face. (Rulon Clark, the snake expert whom we met in the chapter on heat, describes them as a "particularly obnoxious prey item.")

All of these creatures are connected by sound. Their lives and deaths are determined by the frequencies they can hear, how sensitive they are to those frequencies, and their skill at localizing the source of sound. Every species has its own strengths and weaknesses. An owl is maximally sensitive to the frequencies produced by scurrying mice and can locate those sounds with almost unmatched accuracy, but it's oblivious to the highest and deepest notes that human ears can detect. Mice can't hear the low

wingbeats of an owl, but they can make high-pitched alarm calls that the owl can't hear. As with other senses, an animal's hearing is tuned to its needs. And some animals don't need to hear at all.

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OUR ROUNDED EARS might look very different from the pointy triangles of fennec foxes, the giant flaps of elephants, or the simple holes of dolphins, but these differences are superficial. Most mammals have very good hearing, and most mammalian ears are very similar. They always exist, for a start. There are always two of them. They're always found on the head. None of these absolutes is absolutely true for insects. They have also evolved ears, but those ears come in a dazzling variety that offers three important lessons about why animals hear at all.

The first lesson: Hearing is useful, but not universally so in the way that touch or nociception is. After all, the first insects were deaf. They had to evolve ears, and over their 480-million-year history, they did so on at least 19 independent occasions, and on almost every imaginable body part. Ears exist on the knees of crickets and katydids, the abdomens of locusts and cicadas, and the mouths of hawkmoths. Mosquitoes hear with their antennae. Monarch caterpillars hear with a pair of hairs on their midsection. The bladder grasshopper has six pairs of ears running down its abdomen, while mantises have a single cyclopean ear in the middle of their chests.[*5] Insect ears are so diverse because most of them evolved from movement-sensitive structures called chordotonal organs, which are found throughout an insect's body. These organs consist of sensory cells that lie just beneath the hard outer cuticle

and respond to vibrations and stretching motions. They tell insects about the position of their own body parts—beating wings, moving limbs, swelling guts. But since chordotonal organs can also react to very loud airborne sounds, they're almost predisposed to becoming ears. They just need to become more sensitive, and that's easily done by thinning the cuticle lying over them to create an eardrum.[*6] Since this can happen almost anywhere on the body, insects can conjure ears from the unlikeliest of places. It's as if their entire surfaces are primed for hearing.

But many insects haven't exploited this evolutionary gimme. As far as anyone knows, mayflies and dragonflies don't have ears. The majority of beetles don't, either. Indeed, most insects seem to be deaf, and since they handily outnumber all other animal species, it follows that *most animals might be deaf*. This might seem odd, especially since sound seems so omnipresent to those of us who can hear. And yet millions of deaf people do just fine without it, and many animals don't bother with it at all. If you look at our fellow mammals and other vertebrates, you might be forgiven for thinking that hearing is invaluable. If you look at insects, you realize that it is decidedly optional.

As with vision, to think about how animals hear, you have to understand how animals use their ears. Hearing is specifically useful in that it offers fast, precise, long-range, and 24-hour information that allows animals to sense both rapidly moving prey and rapidly approaching threats. Accordingly, many insects seem to have evolved ears to listen out for predators. Many butterflies, including the striking blue morpho, have ears on their wings. These species are silent, so they're certainly not listening to each other. Instead, Jayne Yack has shown that their wing-ears are tuned to the same frequencies produced by predatory

birds. From several feet away, they can hear wingbeats, territorial calls, and probably other relevant sounds like feathers swishing through grass or feet hopping on branches. They're likely using their ears in the same way that a kangaroo rat uses its ears.[*7]

The qualities that make hearing good for detecting predators also predispose it to communication. By producing sounds, and listening out for them, animals can exchange signals over longer distances than surface vibrations would allow, in dark and cluttered spaces that obscure visual cues, and with greater speed than pheromones can achieve. This may explain why, millions of years ago, crickets and katydids started to sing.

The males are the noisy ones. They have a ridge on one of their wings, and a comb-like row of teeth on the other. When they rub these together, they produce a *thrrrrp* sound, which females hear with eardrums on their front legs. Fossilized insects that have the same ridges and combs on their wings suggest that these songs have filled the air for at least 165 million years, and likely much longer. But around 40 million years ago, another group of insects started eavesdropping on the singers: parasitic tachinid flies. Most tachinids track their victims through sight or smell, but *Ormia ochracea*—a yellow, half-inch-long species that's found throughout the Americas—uses sound. Like female crickets, it listens out for the song of a male. Homing in on those dulcet *thrrrrp*s, it lands either on or near the singer, and deposits maggots. These burrow into the cricket and slowly devour him from within.

Ormia's ears are not obvious. But Daniel Robert is so familiar with insect ears that when he first looked at the fly under a microscope in the early 1990s, he instantly recognized a pair of eardrums—two thin oval membranes

just below its neck. (“Maybe I’m too much of a nerd,” Robert tells me.) These ears are very different from those of most flies, which are usually feathery and found on the antennae. They’re much closer to those of a female cricket, and they’re similarly tuned to the frequency of a male’s song. *Ormia* has tapped into the female cricket’s auditory Umwelt and uses it for the same goal: pinpoint an unseen male from afar. If you’ve ever been plagued by a cricket singing somewhere inside your house, you’ll know how hard it is to find the source of the infernal chirping. *Ormia* has no such problem. It can turn toward a singing cricket with an accuracy of 1 degree, which is better than humans, barn owls, and almost every other animal that’s been tested.[*8]

Despite this superlative acuity, *Ormia*’s ears control a very simple behavior: *Find cricket.* That’s true for many insect ears, and Jayne Yack thinks this might also explain why they’ve evolved in such a wide variety of body parts. Ears, she says, tend to appear near the neurons that control the actions for which those ears evolved. Female crickets turn and walk toward singing males, so their ears are on their legs. Mantises and moths execute evasive dives and rolls when they hear predators, so their ears are on or near their wings. (Blow on a dog whistle next to an eared moth, and it will start doing loops and spirals.)

This is the second lesson that insect ears can teach: Hearing can be incredibly simple. One might think that a listening cricket creates a mental representation of what it hears, and compares that against some internal template of an ideal male song. None of that is necessary. Through several painstaking studies, Barbara Webb showed that the female cricket’s ears, and the neurons connected to them, are wired so that she *automatically* recognizes a male’s

song and turns toward it. Her actions are built into her sensory system.[*9] As the sense that underpins most of our music and language, hearing can be hard to separate from sophistication of thought, emotionality, and creativity. But it can be akin to the reaction of a human who kicks out when their knee is stimulated by a hammer.

Even simple behaviors can have big consequences. *Ormia*'s acoustic prowess is so acute that on Hawaii, it once infested a third of male crickets and was seriously suppressing their numbers. In response, the crickets acquired a mutation that warped the comb-like structure on their wings and muted their songs. To avoid the grave, they became as silent as one. This happened within 20 generations, making the "flatwing" crickets one of the fastest cases of evolution that has ever been documented in the wild. The newly silent males are undetectable to *Ormia,* but also to females. The silent males are reduced to loitering around the few males who can still sing, in the hopes of sneakily mating with approaching females. They also still go through the motions of singing, rubbing their wings together as if they could still *thrrrrp* away.

Here, then, is the third lesson from insect ears: Animal hearing can drive the evolution of animal calls, and vice versa. Just as eyes define nature's palette, ears define its voices.

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IN THE SUMMER of 1978, after a long flight, a train journey, and a boat ride, a young graduate student named Mike Ryan finally arrived at Panama's Barro Colorado Island to study frogs. He had been hooked on the amphibians ever since he had witnessed an older biologist identifying one

species after another from their calls alone. If another human could hear so much in what his own ears perceived as a formless cacophony, Ryan wondered, what might the frogs themselves hear? He knew that males called to attract mates, but what parts of the song were the females listening to? What sounds beautiful to a frog?

Initially, Ryan's plan was to study the Panamanian red-eyed tree frog, the same species that his future student Karen Warkentin would focus on two decades later.[*10] But these animals stuck to the canopy and weren't very talkative. When Ryan tried to record their calls, he would instead pick up a much louder species that was shouting at his feet— the túngara frog. "I kept kicking them away to get them to shut up," he tells me. "And then I said: Duh, what if I just study *them*? There are tons of them and they're right in front of me."

Picture, in your mind, an average frog. The túngara frog looks like that. It's about the size of a quarter, with bumpy skin and drab, mossy colors. But what it lacks in visual flamboyance, it makes up for in acoustic flair. After sunset, the males inflate their huge vocal sacs and force air through voice boxes larger than their brains. The result is a short whine that falls in pitch, like a tiny, receding siren. After that, the male might add one or more short, staccato embellishments that are known as chucks. To some human ears, the combined call sounds like "tún-ga-ra"—hence the name. To Ryan, it resembles a sound effect from an old video game.[*11] To a female frog, it sounds like an invitation. She'll sit in front of various males, compare their whines and chucks, choose the most attractive-sounding specimen, and allow him to fertilize her eggs. Courting males might call 5,000 times in a single evening before they're chosen. Ryan knows this because he spent 186

consecutive nights at Barro Colorado, recording the serenades and escapades of a thousand individually marked túngara frogs from dusk to dawn. It was a marathon of voyeurism, from which he learned one crucial fact: Chucks are *very* sexy.

Females almost always go for males who embellish their whines with chucks over males who merely whine. The chucks are so desirable that if a male is reluctant to make them, a female will sometimes body-slam him until he does. Ryan recorded the males' songs and spliced their whines and chucks into different combinations. In a soundproof room, he played pairs of these remixes to females through different speakers and noted which they hopped toward. He learned that a whine is attractive on its own, but a chuck makes it five times more appealing. More chucks are sexier than fewer chucks. Deeper chucks are sexier than higher-pitched ones. These preferences are straightforward. The reasons for them are not.

Ryan found that the frog's inner ear is especially sensitive to frequencies of 2,130 Hz, which is just under the dominant frequency of an average chuck.[*12] Even at a noisy pond, where several species might be calling simultaneously, a female can easily find her own males, because she can hear their calls more acutely than those of other frogs. Larger males sound especially loud and clear since their lower-pitched chucks are closer to the ideal frequency of her inner ear. Perhaps, Ryan reasoned, that's why the túngara ear is tuned in that specific way. Larger males can also fertilize more eggs, so in past generations, females who preferred lower frequencies would have been drawn to males who provided them with more offspring. Their predilections became more common and the species ended up with ears that were tuned to the male's voice.

This narrative is perfectly plausible. It's also completely wrong.

Ryan discovered the actual story by studying the túngara frog's close relatives. These other species all whine, but only a few chuck. And yet, all of them have inner ears that are tuned to the same chuck-adjacent frequency as the túngara frog's. These other frogs are predisposed to find chucks attractive, without ever actually hearing them. Ryan demonstrated this by traveling to Ecuador and studying the Colorado dwarf frog—one of the túngara's chuck-less cousins. He recorded the male's whine, added túngara chucks after them, and played the hybrid calls to the females. "I thought it would scare the hell out of them," he tells me. Instead, the females hopped toward the unfamiliar chimeric sounds. The chucks, which the females had never heard before, proved irresistible because they tapped into a preexisting quirk of their senses.

This discovery flipped Ryan's narrative on its head. The túngara frog's hearing didn't change to match its call. It was the other way around. The frog's ancestor already had ears that were tuned to 2,130 Hz, and the chucks evolved to exploit that bias. The reasons for that ancestral tuning are still unclear: Perhaps that's the pitch produced by a rustling predator, or some other important aspect of the frog's environment. Regardless, the female's aesthetic preference came first, and the male's calls changed to fit her conception of beauty. Ryan calls this phenomenon "sensory exploitation," and he and others have shown that it is common throughout the animal kingdom.[*13] Nature's ears really do define its voices.

Male túngara frogs, for their part, get an easy way to earn their partner's attention. A chuck takes very little effort, and enhances their attractiveness fivefold. "Think of

all the stuff we do to make ourselves more attractive—and this is for free," Ryan says. They ought to chuck as frequently and repeatedly as possible, but they're strangely unwilling to do so. While some individuals have been heard slapping up to seven chucks onto their whine, most add just one or two. Many refuse to chuck at all. Their reticence was puzzling, until Ryan realized that females aren't the only ones listening to their calls.

A year before Ryan arrived at Barro Colorado, his colleague Merlin Tuttle caught a bat with a half-eaten túngara frog in its mouth. This species, the fringe-lipped bat, turned out to be a voracious frog-eater. Tuttle and Ryan showed that it tracks its prey by eavesdropping on its courtship calls, much as *Ormia* does with cricket songs. And the bat, just like female túngara frogs, is particularly drawn to males that add chucks to their whines. The females hear a mate, the bats hear a meal, but both are listening for the same qualities. This leaves the male frogs with an unenviable choice. Their chucks court both females and death. No wonder they sometimes stick to whines.[*14]

I find it astonishing to consider how these creatures have been bound together through their senses. For whatever reason, an ancestral frog had ears that were partial to frequencies of 2,130 Hz. Túngara frogs took advantage of that sensory quirk by adding chucks to their whines. Fringe-lipped bats took advantage of those chucks with an auditory add-on that expanded their hearing into unusually low frequencies for a bat. The frog's Umwelt shaped the frog's calls, which then shaped the bat's Umwelt. The senses dictate what animals find beautiful, and in doing so, they influence the form that beauty takes in the natural world.

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FEW ANIMAL SOUNDS are as beautiful to human ears as the songs of birds. And few bird songs have been studied as intensely as those of zebra finches. Visually, these Australian birds are striking, with gray heads, white chests, orange cheeks, red beaks, and black stripes beneath their eyes that resemble running mascara. Vocally, the males are equally flamboyant, singing complicated and raucous songs. To my ears, they sound like melodic printers. But I also wonder if a zebra finch's song sounds to another zebra finch like it does to me. In terms of pitch, the answer is yes. The frequency range of bird hearing is roughly similar to that of humans, so birds generally hear the same range of pitches that we hear. But their songs can also be incredibly fast. The notes that emerge from a zebra finch's beak fly by so quickly that I can barely distinguish them. Even in the notes I *think* I can hear, there seems to be something more, some intricacy I cannot fully discern, lurking at the edges of my awareness. Surely, the birds can hear something in these songs that I cannot.

Bird enthusiasts have long suspected that bird hearing works on a faster timescale than ours. Some birds prove their temporal prowess by singing dazzlingly synchronized duets, slotting their notes in and around each other's with such precision that the two songs can sound like one. Others, including zebra finches, learn their songs from listening to each other, and so must be able to hear the acoustic minutiae that they then reproduce. The same goes for mimics like mockingbirds. To our ears, the song of the whip-poor-will comprises three notes, but it actually has five, which becomes clear if we slow it down. A

mockingbird doesn’t need the help: When mimicking the whip-poor-will, it gets all five notes.

In the 1960s, before his work on barn owls, Masakazu Konishi found direct evidence that the processing speed of bird hearing is exceptionally fast. He played strings of rapid clicks to sparrows, while recording the electrical activity of neurons in the hearing centers of their brains. The neurons fired once per click, even when the clicks were just 1.3 to 2 milliseconds apart. At such speeds—between 500 and 770 clicks *per second*—a cat’s auditory neurons can only keep to the same tempo around 10 percent of the time. The sparrows’ neurons kept pace perfectly. Even pigeons, whose songs don’t contain rapid sounds, had ears that seemed to resolve them.

Later studies were less clear. From the 1970s onward, Robert Dooling repeatedly failed to find any differences between the ways birds and humans perceived the temporal nature of sounds. For example, he showed that humans can tell if a silent gap of just 2 milliseconds is inserted into an otherwise continuous noise. Birds, surprisingly, don’t do any better. Test after test, “nothing popped out as being different,” Dooling tells me. “We measured birds in a gazillion different ways over the years, but their hearing always looked like a human’s.” It took him a long time to realize the problem: He had been testing birds with simple sounds like pure tones, which are nowhere close to the rich complexity of actual songs. You can visualize a pure tone as a smooth curve that undulates up and down, representing increases and decreases in pressure over time. A bird’s song, when visualized in the same way, looks more like the skyline of a city or the ridgeline of a mountain range. It’s full of jagged bumps, which represent extremely fast shifts that occur within the

span of a single note. Those details are known as the temporal fine structure. They're missing from the pure tones that are typically used to study hearing. And as it happens, they're what songbirds are actually listening for.

Dooling confirmed this through an elegant experiment, in which he asked various songbirds to discriminate between sounds that differed only in their temporal fine structure. This isn't intuitive, so let's use a visual analogy. Imagine taking a movie and reversing the order of every three frames. The color palette would stay the same, the scenes would be composed in the same way, and the plot would still be comprehensible. But *something* would feel off, and you'd likely notice the difference. This is roughly what Dooling did with his birds. He presented them with pairs of buzzy sounds. One consisted of repeated chunks in which the pitch rose over a few milliseconds before falling again. In the other, the pitch of the chunks *fell* over the same range of frequencies, and over the same time period. To a slow ear, both sounds would average out to the same pitch, and seem identical. To a fast ear, they'd be completely different. Dooling found that humans could only distinguish between these sounds if the chunks were longer than 3 to 4 milliseconds. Canaries and budgerigars hit their limit at between 1 and 2 milliseconds. And zebra finches weren't even slightly duped by the shortest 1-millisecond chunks. This experiment clearly showed that birds can hear complexities that are imperceptibly fast to humans. And it so thoroughly contradicted Dooling's previous work that "it kind of freaked me out," he says. Indeed, further tests showed that "our electronics couldn't handle the fine detail that the birds are capable of discriminating." That was the first of many surprises.

A zebra finch's song consists of several distinct syllables that it always sings in the same sequence—A-B-C-D-E. When Beth Vernaleo and a team of Dooling's students reversed one of these syllables—A-B-C-D-E—zebra finches almost always noticed the change. Human listeners couldn't, even after a lot of practice. But when the team doubled the gap between two of the syllables, humans could easily tell—it sounded like a glitch in the recording—and the *finches* were completely oblivious. They couldn't hear the differences between two songs that were obviously different to human ears.

Two students, Shelby Lawson and Adam Fishbein, went even further. They completely shuffled the order of the syllables—C-E-D-A-B. The finches *still* couldn't discriminate between them. The two sequences are patently different, but not different *in a way that matters to the finches.* Even though these birds learn their individual sequence of syllables in their youth, and sing that same unchanging sequence for the rest of their life, "they don't give a crap about the sequences," Dooling says. "They care about what's inside the individual notes." It's as if two conversing humans were paying close attention to the nuances of each other's vowels, while blithely disregarding the order of each other's words.

The answer to my question is clear: A zebra finch's song must sound entirely different to a zebra finch than to us. Their disregard for sequence is especially unexpected, and flies in the face of our intuitions about bird songs. The sequences in those songs are both beautiful and useful to human ears. Birders use them to identify particular species. Neuroscientists study them because of their similarities to human languages. And yet, they might be utterly irrelevant to the birds that produce them. Not all

species behave this way: Budgies seem sensitive to the sequence of notes as well as their fine structure. But many others, including Bengalese finches and canaries, mostly care about the latter. To them, the beauty and significance of the song lie in its minutiae. They ignore the big acoustic picture in favor of the details. They can’t—or don’t care to—hear the forest for the trees.

Humans have the opposite tendency. To our ears, each delivery of a zebra finch’s song sounds the same as the last, and we could be forgiven for thinking that they all carry the same information. But Dooling’s colleague Nora Prior showed that the fine structure of seemingly identical renditions can sound very different to a finch. If she swapped syllable B from one recording with syllable B from another, the birds could hear that something had changed. Their songs must be full of subtle nuance that we simply cannot detect. While we might hear repeated iterations of the same unwavering tune, they could conceivably hear information about sex, health, identity, intention, and more. Zebra finches sing to establish lifelong bonds with their partners, to find each other when they’re apart, to stay together while traveling, and to coordinate their parenting responsibilities. Perhaps they accomplish all of this through information encoded in their songs’ fine structure.

Part of the thrill of listening to animals comes from wondering what they are saying to each other. Writers have conjured up characters like Dr. Dolittle who can understand the meaning of the tweets, bleats, and hisses of other species. Naively, we might imagine this to be a problem of vocabulary, as if there might exist some word-chirp dictionary that would suddenly allow us to speak bird. There isn’t, and Dooling’s work reminds us why: The communication barrier between species is also a sensory

one. Birds encode meaning in aspects of their songs that our ears can't pick out and our brains don't pay attention to. "Now, when I hear birdsong, I think it's amazing that it sounds so complex but I'm *still* missing most of it," Dooling tells me. "There's a lot in there that another bird is appreciating that I can't."

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IN THE EARLY 2000s, while Robert Dooling was running the first of his fine structure experiments, Jeffrey Lucas stumbled upon another unexpected side to bird hearing. He and his colleagues placed electrodes on the scalps of six North American bird species to record how their auditory neurons responded to different sounds. This simple technique is called the auditory evoked potential (AEP) test. Doctors use it to check hearing levels in human patients. Biologists use it to work out what animals can hear. Lucas used it to see if species with more complex songs hear differently than those with simpler tunes. More through accident than planning, he happened to test birds in two waves—one in the winter, and a second in the spring. And when he compared those snapshots in time, he saw that they were very different. Birds, Lucas realized, hear differently across the seasons.

Their hearing changes because of an important trade-off that's inherent to all ears. Let's say I played you two musical notes—one with a frequency of 1,000 Hz, and another with a frequency of 1,050 Hz. These roughly correspond to two adjacent keys at the high end of a piano, which should be easy to tell apart. But if I played 10-millisecond snippets of the two notes, they'd be indistinguishable. Why? Because within that short

timeframe, *both* notes would oscillate 10 times each, and sound the same. If I increased the snippet length to 100 milliseconds, the notes would oscillate 100 times and 105 times, respectively, and sound different. For this reason, animal ears become more adept at discriminating between similar frequencies if their neurons integrate sound information over longer periods of time. But in doing so, they also become *less* sensitive to fast changes that occur within those periods. We saw a similar trade-off in the chapter on vision: Eyes can have exceptional resolution or exceptional sensitivity, but not both. Likewise, ears can have exceptional *temporal resolution* or exceptional *pitch sensitivity*, but not both. "The auditory system that does fast stuff is completely different from the auditory system that does frequency stuff," Lucas tells me. And he found that birds don't have to settle for one or the other. They can flip between the two, as the situation demands.

Consider the Carolina chickadee—a small, inquisitive songbird that graces much of eastern America. Its signature *chick-a-dee-dee* call rapidly changes in pitch and volume, much like the songs of zebra finches. That call can be heard all year round, but it's especially important during the fall, when the sociable chickadees form large flocks. At that time, the birds need to parse all the information encoded within the fine structure of their calls, so their hearing needs to be as fast as possible—and it is. Lucas found that in the fall, their temporal resolution goes up, but their pitch sensitivity goes down. When spring rolls around, everything changes. The flocks begin to break up, as females and males pair up to establish their own breeding territories. To attract mates, the chickadee males start singing their courtship songs, which are much simpler than their year-round calls. There are four notes—*fee-bee-fee-*

bay—and each is close to a pure tone. The male's attractiveness depends on how consistently he can sing these notes, and specifically on whether he can maintain the exact drop in pitch between the *fee* and the *bee*. Now the chickadees need to hear the frequencies of their songs as sharply and precisely as possible—and they do. While speed takes all in the fall, pitch is king in the spring.

The hearing of the white-breasted nuthatch changes in the opposite direction. Its courtship song—a nasal, fast-paced *wha-wha-wha*—has a fine structure that includes fast changes in volume. So, unlike the chickadee, its hearing becomes *faster* during the breeding season, and less sensitive to pitch. Both birds completely retune their sense of hearing from one season to the next to process the information that matters most in that season. Their voices and their needs change with the calendar. So do their ears.

These changes are driven by sex hormones like estrogen, which can directly influence the hair cells in songbird ears. This might explain why in some species, the hearing of males and females changes in different ways. Lucas and his colleague Megan Gall showed that female house sparrows have seasonal hearing that shifts in the same way as the chickadees': It gets better at handling pitch in the spring at the expense of speed. Male hearing, however, stays fast all year round. So, while Robert Dooling showed that humans experience bird songs in a different way than birds, Lucas showed that birds can also experience *their own songs* in different ways, depending on their sex and the season. In the fall, all house sparrows hear in the same way. In the spring, males and females get different experiences of the same tunes. Their Umwelten converge and diverge throughout the year.

These cycles influence more than their sense of aesthetics. As we saw with both owls and *Ormia,* animals can calculate where sounds are coming from by noting if those sounds reach one ear slightly later than the other. If ears become worse at detecting small time differences, their owners become worse at mapping sounds. So when a female sparrow's sense of acoustic timing becomes slightly slower in the spring, her acoustic *space* also becomes slightly fuzzier.

These seasonal cycles shocked Lucas when he first discovered them in 2002. Other researchers didn't believe his early results, either. At the time, people thought that hearing was mostly static. It might get duller with age in some species—humans, sadly, among them—but it wasn't thought to change over shorter timescales. But as we've repeatedly seen, an animal's senses are finely tuned to its environment and have evolved to extract whatever information is relevant. When the environment fluctuates from one season to the next, the information that's relevant also changes.[*15] For a North American bird, spring often means sex. The air fills with courtship calls that are absent in other times of year and must now be carefully judged. Fall brings openness: Bare branches make little birds more visible to predators. The ability to localize the sound of approaching danger, which is inextricably linked to fast hearing, becomes paramount. An animal's Umwelt cannot be static, because an animal's world isn't static.

Bird songs don't lie beyond the reach of human senses, like the circularly polarized patterns of mantis shrimps or the vibrational songs of treehoppers. We can very much hear them. The *fee-bee-fee-bay* of chickadees and the *wha-wha-wha* of nuthatches are obvious enough that we can transcribe them. And yet, we still don't appreciate these

signals in the same way as their intended audiences can. To us, a chickadee song sounds the same whether we listen to it in October or March. To a chickadee, it does not. If so much mystery can exist within sounds that we can hear, how much more are we missing in sounds that we can't?

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IN THE 1960S, after his seminal work on barn owls, Roger Payne switched his attention to whales. In 1971, he published two historic papers. One, based on recordings that Payne analyzed with his wife, Katy Payne, revealed for the first time that humpback whales sing haunting songs. It prompted decades of research, turned whale song into a cultural phenomenon, spawned a bestselling album, and helped to spark the Save the Whales movement. The second showed that fin whales—the second-largest animals after blue whales—make extremely low-pitched calls that can be heard across entire oceans. It nearly destroyed Payne's career.

That controversial paper was born of the Cold War. To listen for Soviet submarines, the U.S. Navy installed chains of underwater listening posts in the Pacific and Atlantic. This network, known as the Sound Surveillance System, or SOSUS, picked up a deluge of oceanic noises. Some were clearly biological. Others were more mysterious. One especially enigmatic sound was monotonous, repetitive, and low, with a frequency of 20 Hz—an octave below the lowest key on a standard piano.[*16] This hum was so loud that people doubted it could be coming from an animal. Did it have a military origin? Was it produced by underwater tectonic activity? Did it come from waves crashing on some distant shoreline? The actual source only became clear

when Navy scientists started following the sounds to their sources, and often found a fin whale at the end.

Human hearing typically bottoms out at around 20 Hz. Below those frequencies, sounds are known as infrasound, and they're mostly inaudible to us unless they're very loud. Infrasounds can travel over incredibly long distances, especially in water.[*17] Knowing that fin whales also produce infrasound, Payne calculated, to his shock, that their calls could conceivably travel for 13,000 miles. No ocean is that wide. Together with oceanographer Douglas Webb, Payne published his calculations, speculating that the largest whales "may be in tenuous acoustic contact throughout a relatively enormous volume of ocean." The response was brutal. Leading whale researchers told him that his paper was pure fantasy. Colleagues hinted that critics had been questioning his mental health behind his back. "When you get to distances like that, people just refuse to believe that it's true," Payne tells me.

Payne's work made a more positive impression on Chris Clark. A young acoustician and former choirboy, Clark was recruited by Roger and Katy Payne to be a sound technician on a 1972 trip to Argentina to study right whales. It was a thrilling and formative time. Camped on a beach beneath the Southern Cross, with penguins bumbling past and albatrosses wheeling overhead, Clark began listening to whales. He placed hydrophones in the water to eavesdrop on their songs and found ways of assigning specific recordings to individual whales. He went on to compile libraries of whale calls, recorded all over the world, from Argentina to the Arctic. And all the while, Payne's idea of giant whales talking over oceans stuck with him.

In the 1990s, with the Cold War over and the threat of Soviet subs diminished, the Navy offered Clark and others

a chance to observe real-time recordings from their SOSUS hydrophones. Amid the spectrograms—visual representations of the sounds that SOSUS picked up—Clark saw the unmistakable signal of a singing blue whale. On his first day, Clark saw that more blue whale vocalizations had been recorded from a single SOSUS sensor than had been described before in the entire scientific literature. The ocean was awash with their calls, and those calls were coming in from enormous distances. Clark calculated that one individual was 1,500 miles from the sensor that recorded it. He could listen to whales singing in Ireland with a microphone situated off Bermuda. "I just thought: *Roger was right,*" he says. "It is physically possible to detect a blue whale singing across an ocean basin." For Navy analysts, these sounds were regular parts of their workday, irrelevancies to be marked on the spectrograms and promptly ignored. For Clark, they were mind-blowing epiphanies.

Although blue and fin whale songs can traverse oceans, no one knows if the whales actually communicate at such ranges. It's possible that they're signaling to nearby individuals with very loud calls, which just happen to extend further afield. But Clark points out that they repeat the same notes, over and over again, and at very precise intervals. A singing whale will stop calling when it surfaces for air, and come back on the beat when it submerges. "That's not arbitrary," he says. It reminds him of the redundant and repetitive signals that Martian rovers use to beam data back to Earth. If you wanted to design a signal that *could* be used to communicate across oceans, you'd come up with something similar to a blue whale's song.

Those songs might have other uses, too. Their notes can last for several seconds, with wavelengths as long as a

football field. Clark once asked a Navy friend what he could do with such a call. “I could illuminate the ocean,” the friend replied. That is, he could map distant underwater landscapes, from submerged mountains to the seafloor itself, by processing the echoes returning from the far-reaching infrasounds. Geophysicists can certainly use fin whale songs to map the density of the ocean crust. But can the whales do so?

Clark sees evidence in their movements. Through SOSUS, he has seen blue whales emerging in polar waters between Iceland and Greenland and making a beeline—a whaleline?—for tropical Bermuda, singing all the way. He has seen whales slaloming between underwater mountain ranges, zigging and zagging between landmarks hundreds of miles apart. “When you watch these animals move, it’s as if they have an acoustic map of the oceans,” he says. He also suspects that the animals can build up such maps over their long lives, accruing sound-based memories that lurk in their mind’s ear. After all, Clark recalls veteran sonar specialists telling him that different parts of the sea had their own distinctive sounds. “They said: If you put a pair of headphones on me, I can tell you if I’m near Labrador or off the Bay of Biscay,” says Clark. “I thought that if a human being could do this in 30 years, what could an animal do with 10 million years?”

The scale of a whale’s hearing is hard to grapple with. There’s the spatial vastness, of course, but also an expanse of time. Underwater, sound waves take just under a minute to cover 50 miles. If a whale hears the song of another whale from a distance of 1,500 miles, it’s really listening back in time by about half an hour, like an astronomer gazing upon the ancient light of a distant star. If a whale is trying to sense a mountain 500 miles away, it has to

somehow connect its own call with an echo that arrives 10 minutes later. That might seem preposterous, but consider that a blue whale's heart beats around 30 times a minute at the surface, and can slow to just 2 beats a minute on a dive. They surely operate on very different timescales than we do. If a zebra finch hears beauty in the milliseconds within a single note, perhaps a blue whale does the same over seconds and minutes.[*18] To imagine their lives, "you have to stretch your thinking to completely different levels of dimension," Clark tells me. He compares the experience to looking at the night sky through a toy telescope and then witnessing its full majesty through NASA's spaceborne Hubble telescope. When he thinks about whales, the world feels bigger, stretching out in space and time.

Whales weren't always big. They evolved from small, hoofed, deer-like animals that took to the water around 50 million years ago. Those ancestral creatures probably had vanilla mammalian hearing. But as they adapted for an aquatic life, one group of them—the filter-feeding mysticetes, which include blues, fins, and humpbacks—shifted their hearing to low infrasonic frequencies. At the same time, their bodies ballooned into some of the largest Earth has ever seen. These changes are probably connected. The mysticetes achieved their huge size by evolving a unique style of feeding, which allows them to subsist upon tiny crustaceans called krill. Accelerating into a krill swarm, a blue whale expands its mouth to engulf a volume of water as large as its own body, swallowing half a million calories in one gulp. But this strategy comes at a cost. Krill aren't evenly distributed across the oceans, so to sustain their large bodies, blue whales must migrate over long distances. The same giant proportions that force them to undergo these long journeys also equip them with the

means to do so—the ability to make and hear sounds that are lower, louder, and more far-reaching than those of other animals.

Back in 1971, Roger Payne speculated that foraging whales could use these sounds to stay in touch over long distances. If they simply called when fed and stayed silent when hungry, they could collectively comb an ocean basin for food and home in on bountiful areas that lucky individuals have found. A whale pod, Payne suggested, might be a massively dispersed network of acoustically connected individuals, which seem to be swimming alone but are actually together. And as his partner Katy later showed, the largest animals on land might use infrasound in the same way.

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IN MAY 1984, Katy Payne found herself in the company of several Asian elephants at Washington Park Zoo in Portland, Oregon, 16 years after she and Roger Payne learned that humpback whales sing. She was searching for another species to study, and elephants, which were also intelligent and sociable, seemed like good candidates. As she observed them, she occasionally felt a deep shuddering sensation in her body. “ It had been like the feeling of thunder but there’d been no thunder,” she later wrote in her memoir, *Silent Thunder*. “There had been no loud sound at all, just throbbing and then nothing.” The feeling stirred a memory from her teens, of singing in a chapel choir while the pipe organ shook her body as it played its deepest notes. Maybe, Payne reasoned, the elephants had affected her in the same way because they were also producing

imperceptibly deep notes. Maybe they were conversing in infrasound, just as some whales were said to do.

Payne returned to the zoo in October with two colleagues and some recording equipment. They left the recorders running while keeping round-the-clock notes on the animals' behavior. Payne didn't listen to the tapes until Thanksgiving eve, and she began with a recording from one especially memorable event. She had felt that familiar silent throbbing at a time when two elephants—Rosy, the matriarch, and Tunga, a male—were facing each other on opposite sides of a concrete wall. At the time, they seemed silent. But when Payne sped up the recordings from that encounter, raising their pitch by three octaves, she heard what sounded like mooing cows. Across their concrete divide, and unbeknownst to the nearby humans, Rosy and Tunga had been having an animated chat. That night, she had a dream in which she was visited by a group of elephants. The matriarch said, "We did not reveal this to you so you would tell other people." Payne interpreted this not as a call for secrecy but as an invitation: *We revealed it to you not to make you famous among people, but to give you access to us*.

Payne's discovery, which she published in 1984, made perfect sense to Joyce Poole and Cynthia Moss, who had been studying African elephants in Kenya's Amboseli National Park. They'd noticed that elephant families would often move in the same directions for weeks at a time, even though they were separated by several miles. In the early evenings, different groups would also converge on the same waterholes at the same time, but from different directions. Infrasound carries over long distances, even in air, and if elephants use it to communicate, that would explain how they can synchronize their movements across a

savannah. Poole and Moss invited Payne to join them. She accepted, and in 1986, the team showed that African elephants use infrasound just like their Asian counterparts—and in every conceivable context. There are contact rumbles that help individuals find each other. There are greeting rumbles that they make when reuniting after a separation. Males make rumbles when in heat, and females make rumbles in response to them. There's a "let's go" rumble, and an "I just had sex" rumble. At close range, most of these rumbles contain frequencies audible to human ears, but some became apparent only when the team sped up their recordings, or visualized them.

These infrasonic rumbles are airborne sounds, so they're partly distinct from the surface-borne signals that Caitlin O'Connell more recently identified, and that we encountered in the last chapter. Both are mostly imperceptible to us, and both can be detected by other elephants over long ranges. The low-frequency parts of the rumbles range between 14 and 35 Hz—about the same as a large whale's. Those calls don't carry as far in the air as underwater, and atmospheric conditions dictate how far they can travel: The colder, clearer, and calmer the air, the greater the range. In the heat of midday, an elephant's auditory world shrinks. A few hours after sunset, it expands tenfold, theoretically allowing elephants to hear each other over several miles.[*19] "But we really don't know how far these animals are listening to each other, or what they're listening for," Payne says. "That's a very important question, and no one can answer it."

The same applies to whales. Much of what Roger Payne, Chris Clark, and others have theorized is still speculative, based on little snapshots of whale behavior and educated guesses about what they should be capable of. When it

comes to the largest animals that live or have ever lived, actual data are hard to come by, and experiments are nigh impossible. Birds, by contrast, can be easily housed in cages, and bird songs have been analyzed for centuries. And yet, it was 2002 before Robert Dooling discovered that some species pay attention to temporal fine structure at the expense of qualities we can hear. If it's that hard to understand the Umwelt of a bird, no wonder scientists barely understand what giant whales are really listening for in each other's calls. Are those songs courtship displays? Territorial calls? Dinner bells? Assertions of identity? No one knows. Even if you could find a blue whale and play a recorded song to it, how would you expect the animal to behave?

No one even knows for sure what a mysticete whale's hearing range is. The AEP method, where researchers play sounds to an animal and record its neural responses through electrodes on its scalp, is impossible to use on a free-swimming blue whale. Researchers have managed to use AEP on smaller whales and dolphins that either strand or live in captivity, but mysticetes rarely do the former and never do the latter. In lieu of direct measurements, scientists like Darlene Ketten have estimated what these giants hear by analyzing their ears with medical scanners. Her work strongly suggests that they hear the same infrasonic frequencies that are found in their calls. What they do with that sense is another matter.

There are still holes in Payne's and Clark's ideas. Only male blue whales seem to sing, so if they're really navigating or communicating with their calls, then what are females doing? There's also the matter of proportions. A 20 Hz note has a wavelength of 75 meters, which means that the distance between two peaks of pressure is two to

three times as long as the longest blue or fin whale. These superlatively big animals have the same problem as the tiny *Ormia* fly: Their calls should sound the same to both ears, so it shouldn't be possible to track their source. "It may be impossible, but watch that fly!" Clark says. "I don't believe in spirits or astrology, but don't underestimate evolution. I've been more than chastised in scientific meetings for proposing all these preposterous things that I can never prove. But I'd much rather be open-minded. And I constantly try to put myself in the space of the animal."

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WHILE ELEPHANTS AND whales produce calls that are below the range of human hearing, other species go above it. In the winter of 1877, Joseph Sidebotham was staying in a hotel at Menton, France, when he heard what sounded like a canary singing on his balcony. He soon discovered that the singer was actually a mouse. He fed it with biscuits, and it reciprocated by singing for hours by the fireplace, cranking out a tune as beautiful as that of any bird. His son suggested that all mice might sing similar melodies at pitches too high for humans to hear. Sidebotham disagreed. "I am inclined to think the gift of singing in mice is but of very rare occurrence," he wrote to the journal *Nature.*

He was wrong. Roughly a century later, scientists realized that mice, rats, and many other rodents do indeed make a wide repertoire of "ultrasonic" calls, with frequencies too high to be audible to humans. They make these sounds when playing or mating, when stressed or cold, when aggressive or submissive. Pups that are separated from their nests make ultrasonic "isolation calls" that summon their mothers. Rats that are tickled by

humans make ultrasonic chirps that have been compared to laughter. Richardson's ground squirrels produce ultrasonic alarm calls when they detect a predator (or a tan fedora repeatedly thrown by a scientist to mimic a predator). Male mice that sniff female hormones produce ultrasonic songs that are remarkably similar to those of birds, complete with distinctive syllables and phrases. Females attracted to these serenades join their chosen partners in an ultrasonic duet. Rodents are among the most common and intensively studied mammals in the world and have been fixtures of laboratories since the seventeenth century. All that time, they've been spiritedly talking to each other without any human realizing, exchanging messages that slipped beneath the senses of the oblivious researchers and technicians milling around them.

Like *infrasound,* the term *ultrasound* is an anthropocentric affectation. It refers to sound waves with frequencies higher than 20 kHz, which marks the upper limit of the average human ear. It seems special—*ultra,* even—because we can't hear it. But the vast majority of mammals actually hear very well into that range, and it's likely that the ancestors of our group did, too. Even our closest relatives, chimpanzees, can hear close to 30 kHz. A dog can hear 45 kHz; a cat, 85 kHz; a mouse, 100 kHz; and a bottlenose dolphin, 150 kHz. For all of these creatures, ultrasound is just sound. Many scientists have suggested that ultrasound offers animals a private communication channel that other ears can't eavesdrop upon—the same claim that was made about ultraviolet light. We can't hear these sounds, so we bill them as "hidden" and "secretive," even though they're patently audible to many other species.

Rickye and Henry Heffner have a different explanation for why so many mammals can hear ultrasound: It helps them work out where that sound is coming from. Like barn owls, mammals do this by comparing when a sound arrives at their two ears. But as the space between those ears goes down, such comparisons only become possible for higher frequencies with shorter wavelengths. As a general rule, the smaller a mammal's head, the higher its hearing range. The boundaries of our auditory worlds are set by the physics of sound hitting our skulls.[*20]

High-frequency sounds may be easier to locate, but they have an important limitation. They lose energy quickly, and can be easily scattered and reflected by obstacles like leaves, grasses, and branches. This means that ultrasonic calls can only spread over short ranges. A singing blue whale might be heard across an ocean, but a singing mouse is only audible to its immediate neighbors. This limited range might explain why relatively few mammals—rodents, toothed whales, small bats, domestic cats, and a few others—use ultrasound to communicate even though they can hear those frequencies. The sounds just die off too quickly. (This is also why devices that claim to repel pests with ultrasound don't really work: Their range is far too limited to be of much practical use.)

A limited range might be beneficial, however, if animals want to limit their audience. The isolation call of a helpless mouse pup can alert a nearby parent without also alerting more distant predators. In this way, ultrasound really can provide a secret communication channel, not because it lies in an inaccessible frequency range but because it doesn't travel very far. Annoyingly, that limited range makes ultrasound even harder to study: We can't hear it, and even if we could, we might not be close enough to do so. Given

how long it took to learn that rodents use ultrasound extensively in their social lives, it's entirely possible that such communication is far more abundant among animals than we currently appreciate.

Many examples of ultrasonic communication were only discovered when scientists noticed that animals seemed to be screaming silently, going through all the motions of making a call but without unleashing any actual noise. That's what Marissa Ramsier noticed while watching Philippine tarsiers—fist-sized, big-eyed primates that look like gremlins. They would open their mouths, but no sound would emerge. Ramsier only heard what they were saying by placing them in front of an ultrasound detector. Their calls, she learned, have frequencies of 70 kHz—well above the ultrasonic boundary and higher than any mammal aside from bats or cetaceans. What are they saying? What are they listening for, besides each other?

Hummingbirds are even more mysterious. As with Ramsier's experience with tarsiers, many observers have noticed hummingbirds opening their beaks and fluttering their chests without seeming to sing. The blue-throated hummingbird of North America sings an elaborate song that we can partly hear, but that also extends up to 30 kHz—well into the ultrasonic range. That was surprising since, as Carolyn Pytte showed in 2004, it can't hear above 7 kHz. It can still perceive the lower registers of its song, but much of what it sings is inaudible to its own ears. Several other hummingbirds, like the black jacobin and the violet-tailed sylph, make calls beyond the hearing of most birds, and the part of these songs that people can perceive sounds like crickets. The Ecuadorian hillstar goes even further, singing entire phrases in an ultrasonic register. Birds tend to have similar hearing ranges that top out

before 10 kHz. So either these hummingbirds have very unusual ears or they can't actually hear what they're saying.[*21] And if the latter is true, then why are their songs so high-pitched? Calls demand listeners. If the hummingbirds' tunes lie beyond their own Umwelten, who's the audience?

Maybe it's insects? Even though most insects can't hear at all, many of those with ears can hear ultrasonic frequencies. More than half of the 160,000 species of moths and butterflies are so equipped. The greater wax moth can even hear frequencies near 300 kHz—the highest limit of any animal by some margin. Hummingbirds eat insects as well as nectar, so perhaps they produce ultrasonic calls that they can't hear to flush out the insects that can.

But why did so many insects evolve ultrasonic hearing, especially since most of them can't hear at all? It certainly wasn't to hear hummingbirds, which are relatively recent evolutionary arrivals. It probably wasn't to hear each other, since many of them are silent.[*22] The most likely answer is that their ears were tuned to extremely high pitches to listen out for their nemeses, which appeared around 65 million years ago—bats. Bats evolved the ability both to call and to hear at ultrasonic frequencies, and they combined these traits into one of the most extraordinary animal senses of all.[*23]

SKIP NOTES

*1 These hair cells are similar to those in the lateral lines of fish, because both the ear and the lateral line likely evolved from the same ancestral sensory system.

*2 Some other differences: The owl's cochlea is curved like a banana, while yours is coiled like a snail shell, and its middle ear has just one bone instead of three. Also, unlike mammals, barn owls and other birds have ageless ears. Their hair cells regenerate, and the sensitivity of their hearing barely decreases with age. Confusingly, the prominent tufts of the long-eared owl, the short-eared owl, and their relatives are just ornaments that aren't actually part of the ear and aren't involved in hearing.

*3 Even a barn owl can't hear everything, though. Like humans and every other animal, it can only detect sounds within a certain range of frequencies, or pitches. That range is determined by the hair cells in its cochlea, which are arrayed on a long strip called the basilar membrane. The base of that membrane vibrates at lower frequencies, while the tip vibrates at higher ones. Based on which parts of the strip are vibrating, and thus which hair cells are being stimulated, the owl's brain can work out which frequencies are hitting its ear. The length, thickness, shape, and stiffness of the membrane determine the upper and lower limits of its hearing range. On average, humans can hear sounds between 20 Hz and 20 kHz, while owls have a slightly narrower hearing range, between 200 Hz and 12 kHz. Within that range, they're especially sensitive to anything between 4 and 8 kHz, which not coincidentally covers the frequencies that mice make when they scamper through leaf litter.

*4 We localize sounds without consciously thinking about it, which conceals how hard that task actually is. An eye comes with an inbuilt sense of space, because light from different parts of the world falls on different parts of the retina. But ears are set up to capture qualities like frequency and loudness that have no intrinsic spatial component. For an animal to take that information and turn it into a map of the world, its brain has to work really hard.

*5 In 1968, a zoologist named David Pye published a delightful five-verse poem about insect ears in *Nature,* one of the world's top-ranking science journals. By 2004, scientists had learned so much more about these ears that Pye was compelled to publish a sequel with 12 extra verses. " In later years some further ears / Were found in other forms. / The more we know just goes to show / There are no real norms," he wrote.

*6 Not all insect ears have eardrums. The antennae of mosquitoes and the hairs of monarch caterpillars act more like the airflow-sensing hairs of spiders and crickets, which we met in Chapter 6.

*7 The ear's aptitude for detecting predators might explain why some insect groups haven't bothered evolving them. Perhaps mayflies, which have no ears,

take to the air in such large numbers that they find safety from predators without needing an early-warning system. Maybe dragonflies, which are also earless, rely on their excellent eyesight to spot incoming danger, and their aeronautical acumen to evade even close-range attacks.

*8 The barn owl showed us that animals can work out where a sound is coming from by comparing the time at which it arrives at each ear. But as animals get smaller, their ears get closer together, and sounds reach both of them almost simultaneously. *Ormia*'s ears are less than half a millimeter apart—the width of the dot on this *i*. At such tiny distances, a cricket's song should hit the two eardrums no more than 1.5 microseconds apart—a time window so narrow that it might as well not exist. (For comparison, human ears need separations of at least 500 microseconds to accurately localize a sound.) But Robert and his mentor Ron Hoy showed that *Ormia*'s eardrums, unlike ours, are connected. Within the fly's tiny head, they are linked by a flexible lever that looks like a coat hanger. When sound vibrates one eardrum, the lever transmits those vibrations to the opposite one—but with a slight delay of around 50 microseconds. This greatly extends the time difference between the two ears, and makes the difference between *Ormia* hearing a cricket and *Ormia* hearing a cricket over there.

*9 Webb even built a simple robot that behaves exactly like a female cricket and can track a singing male even though it has no internal conception of his song.

*10 Rex Cocroft, the treehopper aficionado whom we met in the last chapter, was also one of Ryan's students.

*11 Ryan does a very good túngara frog impression, but to my disappointment, he has never tried playing his own rendition through a speaker to see if he can fool an actual female. "I should do that," he tells me.

*12 Technically, the frog has two hearing organs in its inner ear. One, the amphibian papilla, is most sensitive to the pitch of the whine—700 Hz. The other, the basilar papilla, is tuned to the frequency of the chuck.

*13 Sensory exploitation works across the senses. In swordtail fish, the bottom half of the male's tail fin is unusually long. The longer this sword, the more attractive the male is to females. But Alexandra Basolo found that this same preference exists in the closely related and swordless platyfish. If she glued artificial swords onto the tails of platyfish males, they became more attractive. The sword, then, is like the túngara frog's chuck—a trait that evolved to exploit a preexisting preference.

*14 Ryan remembers that after he first presented his bat findings at a seminar, a very senior researcher told him that he was wrong. Bat ears are tuned to the exceptionally high frequencies of their own calls, Professor Bigshot said, and should be deaf to the lower notes of a túngara chuck. Undeterred, Ryan showed that they are not. Their inner ears are wired up to more neurons than those of almost any other mammal, and uniquely among bats, a subset of these are sensitive to the low frequencies found in frog calls. It's as if they've added a special frog-detecting module onto what is otherwise basic bat hardware. One of Ryan's students, Rachel Page, later showed that under some circumstances, the bats find it easier to locate the frogs if they're chucking as well as whining. They aren't the only eavesdroppers, either. Another of Ryan's students, Ximena Bernal, showed that bloodsucking midges are drawn to frog calls, and especially to those with chucks.

*15 Males of the plainfin midshipman fish attract females by making long and very deep hums, and during the breeding season, the females' ears become several times more sensitive to the main frequencies. Green tree frogs become more sensitive to their own calls after just two weeks of listening to a chorus.

*16 Hearing ranges don't have sharp boundaries. Instead, it just becomes harder and harder to hear sounds at a specific volume. Humans, for example, can hear some infrasonic frequencies if they're loud enough.

*17 Humans exploited this property during World War II, when aircraft were armed with explosive charges that went off if the planes sank. Listening posts could detect the locations of the wrecks, and rescue teams could be deployed.

*18 There's a running joke in Pixar's *Finding Nemo* where the protagonist Dory speaks whale by saying the usual things loudly and slowly. Talking to Clark, I wonder if that's surprisingly accurate.

*19 Other land animals experience the same expansions and contractions, which is why songbirds sing at dawn and wolves howl at night. Nightfall also increases the range over which a predator might pick up on a call, which might be why elephants call most often in the late afternoon, when their sounds travel reasonably far but lions are still snoozing.

*20 Subterranean animals are a striking exception. Their hearing range is much lower than expected for the size of their heads, perhaps because they don't need to localize sounds, and instead use surface-borne vibrations.

*21 It might seem absurd to think that an animal couldn't hear its own calls, but there's at least one clear example where that's the case—the pumpkin toadlet of Brazil. This orange frog is insensitive to the frequencies in its calls, but calls all the same, perhaps because the sight of its inflating vocal sacs is attractive to mates.

*22 Some moths do make ultrasonic courtship calls. Males will follow a female's pheromone trail, land next to her, and vibrate their wings to produce a volley of ultrasound. These calls are very quiet, almost like whispers. Like other ultrasonic communicators, these moths are probably making use of ultrasound's limited range so that they'll be heard by a prospective mate sitting nearby, but not by a hungry bat flying overhead. But unlike most songs, ultrasonic or otherwise, these calls aren't meant to be attractive. They're meant to sound dangerous. They mimic the calls of bats, prompting the females to freeze and allowing the males to mate more easily.

*23 For years, hundreds of textbooks and scientific papers have claimed that echolocating bats drove the evolution of ears in moths and other insects. But halfway through writing this book, I (and the wider scientific community) learned that this narrative is false. Moth ears almost always evolved before bat ultrasound, by at least 28 and as many as 42 million years. They only shifted toward higher frequencies once bats arrived on the scene. As sensory biologist Jesse Barber tells me, "Most of the introductions I've written in my papers are wrong."

9.

A Silent World Shouts Back

Echoes

As I look through the window of a heavy door, a gloved hand on the other side holds up a ball of brown fur with long ears and a dark Chihuahua-like face. This is Zipper. She's a big brown bat—one of seven spending the summer at Boise State University under the care of Jesse Barber. Big browns are certainly brown, but, at roughly the weight of a mouse, they're only big relative to other small bats. They thrive in attics throughout the United States, but since they're nocturnal and quiet, people rarely see them, and certainly not at this distance. They emerge at dusk to chase after moths and other night-flying insects, and Zipper was so named because she's especially good at maneuvering. Some of her roommates have been given food-related epithets like Ramen, Pickles, and Tater. Others were named for their personalities: Casper (after the ghost) is friendly; Benny (after a character in *Rent*) is vocal. All these bats will be released in October in time for hibernation, but until then, they're in for a cushy summer, dining on juicy mealworms, snuggling up in warm cages, and going on regular "flight walks." "We take them out of their cages to let them exercise," Barber tells me. "It's like having 16 dogs."

As I watch Zipper through the window, she opens her mouth, exposing her surprisingly long teeth. This isn't an aggressive display. She's trying to make sense of her surroundings. She's unleashing a stream of short,

ultrasonic pulses from her mouth. By listening for the returning echoes, she can detect and locate objects around her—a form of biological sonar. Only a few animals have this skill, and only two groups have perfected it: toothed whales (like dolphins, orcas, and sperm whales) and bats. Currently, Zipper's sonar is telling her that there's a solid barrier in front of her, even though she can see large creatures standing beyond it. (Despite the common idiom, bats aren't blind.) It must be a little confusing, but in fairness, Zipper's ability didn't evolve to detect windows. It evolved to find small insects at night when vision is limited. During the day, sharp-eyed predators like birds have their way with bugs. At night, those prey belong to bats. Since we rarely see bats, it's easy to mistake them for ecological B-listers that dine on the nocturnal scraps that birds leave behind. It's actually the other way round: In some rainforests, bats devour twice as many insects as birds. And when Zipper's handlers take her into an adjacent flight room and release moths into the air, I start to understand why.

The flight room, which is completely dark, is watched by three infrared cameras. The handlers inside can only hear the sounds of flapping. Everyone outside—Barber, his student Juliette Rubin, and I—can see what's happening on a monitor. And what we see is Zipper, for whom darkness is no impediment, slicing through the air and catching moth after moth. Outside, Rubin and Barber whoop and cheer like excited sports fans.

RUBIN: Did she get it? No, she just touched it.

BARBER: There it is…. OOOOOHHHHH.

RUBIN: Second interaction. Third. She's gonna get it. This bat is so good.

BARBER: That moth's pretty good too….

RUBIN: OH, got it. Knew it!

HANDLERS, ON THE WALKIE-TALKIE: Did she get it?

RUBIN: Yeah, she did, the badass.

BARBER, TO ME: She'll need a minute to consume it.

RUBIN: This one's eaten two lunas, some wax moths, plus mealworms. She's an empty pit.

[The team gives Zipper a break, takes Poppy—another bat—into the room, and releases another moth.]

RUBIN: Okay, we're rolling. Ooooh, nice. Whoa! Oh my gosh. She is…OH, did you *see* that acceleration she just did?

EVERYONE, INCLUDING ME: WHOAAAAAA!

The images on the monitor are monochrome and grainy, but, on his laptop, Barber shows me several videos that he captured with much better cameras. In slow motion and high definition, a red bat does a double backflip, catching a moth in its tail and then flipping it into its mouth. A leaf-nosed bat tackles another moth in an explosion of scales. A pallid bat descends upon a scorpion like a dragon. These are bats in their element—and they are glorious. "For many people, when I talk about my research, their first reaction is: Oh, how could you work with those things?" Rubin says. "I forget that most humans think bats are gross, because they're so incredible at what they do—and they look good doing it." They are so misunderstood, so often used as symbols of evil, and so separate from us in altitude and time of day that "some of their most basic biology is unknown," Barber adds. "Bats might as well be in the deep

ocean. We know more about their sonar than any other aspect of their lives."

For a long time we didn't know about their sonar, either. In the 1790s, the Italian priest and biologist Lazzaro Spallanzani realized that bats could still navigate in spaces too dark for a captive owl. In a series of cruel experiments, he showed that bats could orient when blinded, but would blunder into objects when deafened or gagged. He never fully grasped the meaning of these curious findings and could only write that "the ear of the bat serves more efficiently for seeing, or at least for measuring distances, than do its eyes." His contemporaries scoffed at that idea; one philosopher ridiculed it by asking, "Since bats see with their ears, do they hear with their eyes?"

The meaning of these observations remained unclear for more than a century, until a young undergraduate named Donald Griffin came up with a clever idea.[*1] Griffin had spent many hours studying migrating bats and marveled at how they flew through dark caves without face-planting into stalactites. He heard about an untested hypothesis that bats listen out for echoes from high-frequency sounds. And he knew that a local physicist had invented a device that could detect ultrasonic sounds and convert them into audible frequencies. In 1938, Griffin showed up at the man's office with a cage of little brown bats, which he placed in front of the detector. " We were surprised and delighted to hear a medley of raucous noises from the loudspeaker," Griffin wrote in his classic book *Listening in the Dark.*

A year later, Griffin and his fellow student Robert Galambos confirmed that bats make these same ultrasonic cries as they fly, that their ears can detect such frequencies, and that both skills are necessary for them to

avoid obstacles. With mouths and ears unimpeded, they could effortlessly negotiate around a labyrinth of fine wires hung from the ceiling. If their ears were blocked or their mouths were gagged, they were loath to take wing and quick to collide with walls, furniture, and even Griffin and Galambos themselves. The animals were clearly finding their way around by listening to the echoes of their own calls. Others thought this preposterous. As Griffin later recounted, “One distinguished physiologist was so shocked by our presentation at a scientific meeting that he seized Bob [Galambos] by the shoulders and shook him while expostulating: You can’t really mean that!” But the duo did mean it, and in 1944, Griffin gave a name to the bat’s astonishing skill. He called it echolocation.[*2]

Even Griffin underestimated echolocation at first. He saw it merely as a warning system that alerted bats of possible collisions. But his views changed in the summer of 1951. Sitting by a pond near Ithaca, he began to record wild echolocating bats for the first time. Pointing his microphone at the skies, he was shocked by how many ultrasonic cries he heard, and how different these were from those he had witnessed in enclosed spaces. When bats were cruising through open skies, their pulses were longer and duller. When they swooped after insects, the steady *put-put-put*s would quicken and fuse into a staccato buzz. By using a slingshot to launch pebbles in front of the bats, Griffin confirmed that they go through the same sequence of quickening pulses every time they pursue an airborne object. Echolocation, he was staggered to realize, wasn’t just a collision detector. It’s also how bats hunt. “ Our scientific imaginations had simply failed to consider, even speculatively, [this] possibility,” he later wrote.

To study wild bats, Griffin had to stuff a station wagon with microphones, tripods, parabolic reflectors, radios, a generator with a car muffler welded onto it, gasoline tanks, and around 200 feet of extension cord. Technology has progressed since then, and so has the study of echolocation. Back in 1938, the ultrasound detector that Griffin used was one of a kind (and he was appalled when he and Galambos temporarily broke it). When I visit Cindy Moss's state-of-the-art lab in Baltimore 80 years later, I count 21 ultrasonic microphones dotting the walls of just one of two flight rooms. Infrared cameras film the bats as they fly. Laptops represent the bats' inaudible sounds as visible spectrograms, and these displays are precise enough that experienced researchers can use them to identify individual bats. One might have a stutter. Another might have an unusually low voice—a bat baritone.

These gadgets mean that bat echolocation, which was once undetectable to human ears and implausible to human minds, is one of the most accessible of all senses. Of course, "what bats perceive is not yet known," Moss tells me. "That's a really important problem." I mention that this is the same philosophical dilemma that Thomas Nagel discussed in "What Is It Like to Be a Bat?"—that the conscious experiences of other animals are inherently hard to imagine.

"Right," Moss says. And with a wry smile, she adds, "Except he thought you would never know."

—

THERE ARE MORE than 1,400 species of bats. All of them fly. Most of them echolocate.[*3] Echolocation differs from the senses we have met so far, because it involves putting

energy into the environment. Eyes scan, noses sniff, whiskers whisk, and fingers press, but these sense organs are always picking up stimuli that already exist in the wider world. By contrast, an echolocating bat creates the stimulus that it later detects. Without the call, there is no echo. As bat researcher James Simmons explained to me, echolocation is a way of tricking your surroundings into revealing themselves. A bat says, “Marco,” and its surroundings can’t help but say, “Polo.” The bat speaks, and a silent world shouts back.

The basic process seems straightforward. The bat’s call is scattered and reflected by whatever’s around it, and the animal detects and interprets the portion that rebounds. But to successfully do this, a bat must cope with many challenges. I count at least 10.

First, distance is an issue. A bat’s call must be strong enough to make the outward journey to a target and the return journey back to its ears. But sounds quickly lose energy as they travel through air, especially when they’re high in frequency, so echolocation only works over short ranges. An average bat can only detect small moths from around 6 to 9 yards away, and larger ones from around 11 to 13 yards. Anything farther away is probably imperceptible, unless it’s very large, like a building or a tree. Even within the detectable zone, objects on the periphery are fuzzy. That’s because bats concentrate the energy of their calls into a cone, which extends from their heads like the beam of a flashlight; this helps the sounds to carry farther before petering out.[*4]

Volume helps, too. Annemarie Surlykke showed that the sonar call of the big brown bat can leave its mouth at 138 decibels—roughly as loud as a siren or jet engine. Even the so-called whispering bats, which are meant to be quiet, will

emit 110-decibel shrieks, comparable to chainsaws and leaf blowers. These are among the loudest sounds of any land animal, and it's a huge mercy that they're too high-pitched for us to hear. If our ears could detect ultrasound, I would have recoiled in pain while listening to Zipper, and Donald Griffin probably would have fled from the unbearable hubbub of his Ithaca pond.

But bats can hear their own calls, which creates an obvious second challenge: They must avoid deafening themselves with every scream. They do so by contracting the muscles of their middle ears in time with their calls. This desensitizes their hearing while they shout and restores it in time for the echo. More subtly, bats can adjust the sensitivity of their ears as they approach a target so that they perceive the returning echoes at the same steady loudness, no matter how loud the echoes actually are. This is called acoustic gain control, and it likely stabilizes the bat's perception of its target.

The third problem is one of speed. Every echo provides a snapshot. Bats fly so quickly that they must update those snapshots regularly to detect fast-approaching obstacles or fast-escaping prey. John Ratcliffe showed that they do so with vocal muscles that can contract up to 200 times a second—the fastest speeds of any mammalian muscle.[*5] Those muscles don't always contract so quickly. But in the final moments of a hunt, when bats are bearing down upon their targets and need to sense every dodge and dive, they produce as many pulses as their superfast muscles will allow. This is the so-called terminal buzz. It is what Griffin first heard at his Ithaca pond. It is the sound of a bat sensing its prey as sharply as possible, and of an insect likely losing its life.

Fast pulses address the third challenge while creating a fourth. For echolocation to work, a bat must match every outgoing call to its respective echo. If it's calling very quickly, it risks creating a jumbled stream of overlapping calls and echoes that can't be separated and thus can't be interpreted. Most bats avoid this problem by making their calls very short—a few milliseconds long for the big brown. They also space their calls, so that each goes out only after the echo from the preceding one has returned. The air between a big brown bat and its target is only ever filled by a call or an echo, and never both. The bat's control is so fine that even during its rapid terminal buzz, there's no overlap.

After receiving the echoes, the bat must now make sense of them. This fifth challenge is the hardest yet. Consider a simple scenario where a big brown bat is echolocating on a moth. It hears its own call on the way out. After a delay, it hears the echo. The length of that delay tells the bat about its distance to the insect. And as James Simmons and Cindy Moss have shown, the bat's nervous system is so sensitive that it can detect differences in echo delay of just one or two millionths of a second, which translates to a physical distance of less than a millimeter. Through sonar, it gauges the distance to a target with far more precision than any human can with our sharp eyes.[*6]

But echolocation reveals more than just distance. A moth has a complex shape, so its head, body, and wings will all return echoes after slightly different delays. Complicating matters further, a hunting big brown bat produces a call that sweeps across a broad band of frequencies, falling over an octave or two. All of these frequencies bounce off the moth's body parts in subtly different ways, and provide the bat with disparate pieces of

information. Lower frequencies tell it about large features; higher frequencies fill in finer detail. The bat's auditory system somehow analyzes all this information—the time gaps between the call and the various echoes, *at each of their constituent frequencies*—to build a sharper and richer acoustic portrait of the moth. It knows the insect's position, but maybe also its size, shape, texture, and orientation.

All of this would be hard enough if the bat and the moth were staying still. Usually, both are in motion. Hence, the sixth challenge: A bat must constantly adjust its sonar. To even find a moth in the first place, it must scour wide expanses of open air. During this search phase, it makes calls that carry as far as possible—loud, long, infrequent pulses whose energy is concentrated within a narrow frequency band. Once the bat hears a promising echo and approaches the possible target, its strategy changes. It broadens the frequencies of its call to capture more detail about the target and to more accurately estimate its distance. It calls more frequently to get faster updates about the target's position. And it shortens each call to avoid overlapping with the echoes. Finally, once the bat goes in for the kill, it produces the terminal buzz to claim as much information as possible as quickly as possible. Some bats will also broaden the beam of their sonar at this point, widening their sensory zone to better catch moths that try to bank to the side.

The entire hunting sequence, from initial search to terminal buzz, might occur over a matter of seconds. Again and again, bats adjust the length, number, intensity, and frequencies of their calls to strategically control their perception. Handily, this means that a bat's voice reveals its intent. If its call is long and loud, it's focusing on something far away. If the call is soft and short, it's homing

in on something close. If it produces faster pulses, it is paying more attention to a target. By measuring these calls in real time, researchers can almost read a bat's mind.

This approach has helped to explain how bats cope with their seventh challenge—cluttered environments. Bats can race through rugged caves, tangled branches, and even mazes of hanging chains. These messy spaces pose special problems for sonar that don't apply to vision. Imagine that a bat is flying toward two branches that are the same distance away. If it could see them, it could easily tell them apart, because light reflecting off each branch would fall on different parts of its retina. A sense of space is baked into the anatomy of its eye. That's not true for ears. The bat must *compute* space from the timing of its echoes, and since echoes returning from the two equidistant branches would arrive after the same delay, they might sound like the same object.

Cindy Moss showed how bats solve this problem by training big browns to zoom through a hole in a net. She saw that the animals would aim the center of their sonar beams onto the edges of the hole, scanning it before hurtling through. "Just as we can scan different objects in a room with our eyes, the bat can do the same by directing its sonar beam," Moss tells me. She also found that whenever the bats are doing something demanding, like flying around obstacles or chasing erratically moving targets, they shorten their calls and broaden their frequency range to wrest as much detail from the echoes as possible. They also tend to group their calls into distinctive clusters that Moss calls sonar strobe groups (*buh-buh-buh-buh…buh-buh-buh-buh…buh-buh-buh-buh*). Bats may process each group as a unit, summing up the detail from

all the constituent echoes to build a sharper representation of their surroundings.[*7]

Echolocation suffers from another problem—the eighth in our series—that vision does not. Eyes have no problem picking out objects against a background, unless that object is camouflaged. But for sonar, small objects on large backgrounds are automatically camouflaged. If a moth is flying in front of a leaf or sitting upon it, the strong echoes from the leaf would drown out the fainter ones from the moth. Of several solutions to this problem that bats have developed, the common big-eared bat's is the most impressive. Using sonar, and sonar alone, it can grab dragonflies and other insects right off a leaf, even when they're still and silent—a feat that scientists had long considered impossible. Inga Geipel found that the bat pulls off its amazing trick by approaching its prey from a sharp angle, so that echoes from the insect bounce toward it while those from the leaf bounce away. The bat accentuates this effect by hovering upward and downward in front of the insect, with its head fixed upon it. Initially, it probably hears something fuzzy and indistinct—the merest hint of possible prey. But as it slides up and down, gathering information from different angles, the shape of its meal sharpens, and to the insect's misfortune, an impossible feat becomes all too possible.

The ninth challenge arises when bats fly in groups, as they often do. Now they must somehow distinguish the echoes of their own calls from those of other individuals. Big browns do this by aiming their calls away from other bats, shifting the frequencies of their calls to avoid overlapping with other bats' sounds, or taking turns to fly silently.[*8] But such strategies are less useful for Mexican free-tailed bats, which gather in the millions. When 20

million bats are flooding out of a cave together, how on earth does each one pick out its own echoes? Researchers have called this the “cocktail party nightmare,” and it’s not clear how bats wake from it. They might only process echoes that arrive within a certain timeframe, or from a specific direction. They might also ignore echolocation altogether, relying instead on other senses or their memories. Mexican free-tailed bats probably know the path in and out of their caves, and can just follow the right trajectory without needing to consult any echoes. This explains the many historical incidents in which people barricaded the entrances to caves for safety reasons, only to later find that bats had fatally crashed into the doors.

These tragic mishaps illustrate the 10th challenge of echolocation: It takes a lot of effort to solve the other nine. Echolocation is mentally demanding, especially since bats do everything they do at speed. Often they simply don’t have the time to use their sonar to its fullest capacity, which is why they often make ridiculous mistakes that seem beneath them.[*9] They can distinguish two grades of sandpaper whose grains differ by half a millimeter, but will also plow headlong into a newly installed cave door. They can discern flying insects by shape, but will go after a pebble launched into the air. Bats are fully capable of avoiding such errors. They’re just not paying attention. They’re relying on memory and instinct. Humans behave in the same way: Most car accidents occur close to home, in part because drivers are less watchful when going down familiar routes. In both cases, perception is influenced not just by information from sense organs but also by what brains decide to do with that information. Those brains, and their workings, are still mysterious. For all we have learned about echolocation, Nagel was still right: We might

never fully know what it is like to be a bat. But if we dared to take an educated guess, it might be something like this.

It is dark, and you, a big brown bat, are hungry. Easily sensing trees and other large obstacles, you zip around them, searching for insects by lobbing strong, infrequent, and narrow-pitched calls into the intervening air. Most of those calls disappear into the distance, but some return, revealing the presence of something flying at one o'clock. A moth? You turn your head and then your body to keep the target within the cone of your sonar. You know precisely how far away the target is by now, but your perception of it is still blurry. That changes as you draw closer. As your calls shorten, speed up, and broaden in pitch, your sense of the target sharpens—it *is* a moth, a large one, flying away. As you bear down upon the insect, the incredible muscles in your throat unleash the fastest possible barrage of sonar pulses, snapping the moth into sharp focus. Head, body, and wings all become richly detailed even as you scoop the lot into your mouth with your tail. And you accomplish all of that in the time between you reading *this* word…and you reading *this* one.

It is no wonder that bats are so successful. They're found on every continent except Antarctica, and they account for one in every five mammal species. There are bats that pluck insects from the air and bats that pluck fruit from trees. There are bats that catch frogs, bats that drink blood, and bats that sip nectar with tongues more than twice as long as their bodies. There are bat-eating bats. There are bats that go fishing by echolocating on ripples. There are bats that pollinate plants by echolocating on dish-shaped leaves that are adapted to reflect sonar pulses. And there are bats that have solved the challenges of echolocation in a way fundamentally different from what

we've already seen, and have developed the most specialized form of sonar in the world.

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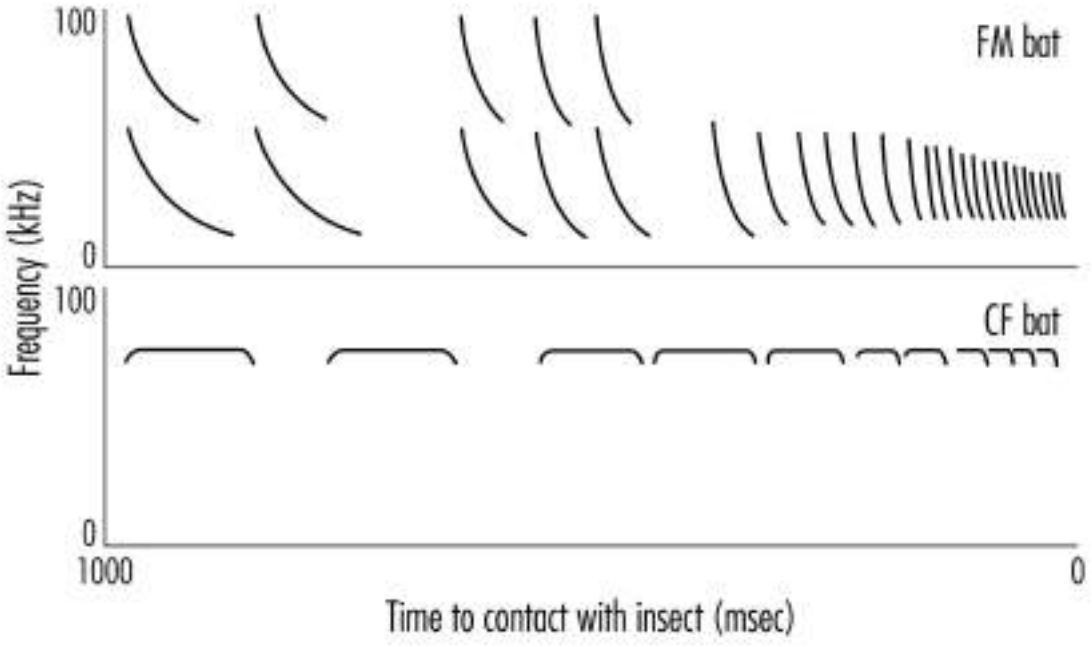
MOST BATS ECHOLOCATE in a way broadly similar to that of the archetypal big brown. They send out short sonar pulses that last between 1 and 20 milliseconds and are separated by relatively longer silences. Those pulses also sweep down across a broad band of frequencies, which is why these bats are known as FM, or frequency-modulated, bats. But around 160 species—the horseshoes, hipposiderids, and Parnell's mustached bat—do something very different. Their calls are much longer, lasting for many tens of milliseconds in some species, and separated by much shorter gaps. And instead of covering a range of frequencies, these species hold one particular note. For that reason, they are called CF, or constant-frequency, bats. And they are listening out for a very specific kind of echo.

When a sonar pulse hits an insect's flapping wing, the echo strength varies as the wing moves up and down. But at one particular moment, when the wing is exactly perpendicular to the incoming sound, an especially loud and sharp echo bounces straight back at the bat. This is called an acoustic glint. It's a dead giveaway that an insect is flying nearby. FM bats can theoretically detect these glints, but they're unlikely to. Their brief sonar pulses are separated by long gaps, so an FM bat has to get very lucky to hit an insect's wing at exactly the right moment to return a glint. By contrast, the pulses of CF bats are long enough to cover an entire wingbeat. They catch glints galore. And since leaves and other background objects don't flap in the same rhythmic way as wings, a CF bat can use glints to

distinguish fluttering insects against cluttering foliage. They must be the auditory equivalent of flashes of light.



These spectrograms show the echolocation calls of two bats as they approach an insect. Note that the FM bat's calls cover a wide range of frequencies, whereas the CF bat mostly holds the same note. But both bats produce shorter and more rapid calls as they approach their prey.

Hans-Ulrich Schnitzler, who has been studying CF bats since the 1960s, has shown that they can recognize different species of insects from the rhythms of their wingbeats. They can tell if the insect is flying toward them or away from them. And they can absolutely tell living targets from inanimate ones: Unlike big brown bats, CF bats won't go after airborne pebbles.[*10]

The ears of CF bats are as specialized as their calls. The greater horseshoe bat, for example, makes a call with a constant frequency of around 83 kHz, and has a disproportionate number of auditory neurons devoted to exactly this pitch.[*11] It hears the sounds of its own echoes

more sensitively than anything else. Other species have their own signature frequencies, as if each CF bat has shaved off a thin slice of the full auditory world and claimed that slice for itself. But this strategy also creates a major problem—an 11th challenge that FM bats do not face.

Sounds seem to rise in pitch as you get closer to their sources—think about what a siren sounds like when an ambulance drives toward you. This is called the Doppler effect. It means that when a CF bat flies at an insect, the echoes it hears get higher in frequency and should eventually overshoot the bat's zone of best hearing. But as Schnitzler discovered in 1967, CF bats can compensate for Doppler shifts. When closing in on a target, they produce calls that are lower than their normal resting frequency, so the upshifted echoes hit their ears at exactly the right pitch. And they do this (quite literally) on the fly, constantly tweaking their calls so that the echoes from targets ahead stay within 0.2 percent of the ideal frequency. This is a staggering feat of motor control that's almost unmatched in the animal kingdom.

Imagine that you have a mistuned piano that always produces notes three tones higher than what you're actually trying to play. If you want middle C, you'll have to press the A on its left. You'd soon get the hang of it—but imagine now that the piano's mistakes aren't systematic, and the gap between the pressed notes and desired notes changes all the time. Now you must constantly judge the size of the gap by listening to the music coming out of the janky instrument, and adjust your fingers as you play. That is what CF bats are doing—many times a second, with almost no errors. They can even do this for several targets simultaneously. A horseshoe bat can throw its attention

between different obstacles at varying distances and perform the right Doppler compensation for each one.[*12]

For a nocturnal insect, no environment is safe from bats. If they fly in open air, big brown bats can grab them. If they head for thick foliage, greater horseshoes can track them. If they land on a surface and stay still, common big-eared bats can still find them. Sonar seems like an unbeatable weapon that can be tailored to any possible habitat. But while it is certainly versatile, it isn't invincible. In evolving an incredible sense, bats opened themselves up to equally incredible illusions.

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IT IS GENTLY snowing inside Jesse Barber's lab, or so it seems. The team members have been carrying moths into the flight room where Zipper and other bats are swooping around, and the insects have left a cloud of white scales hanging in the air. The scales are so pervasive that both Barber and Juliette Rubin have become horribly allergic to them and are now wearing face masks. This, they tell me, is a common occupational hazard among lepidopterists—people who study moths and butterflies. In some circles, it's called lep lung.

When not inflaming the airways of scientists, the scales protect the bodies of moths, by absorbing the sound of a bat's calls and muffling the resulting echoes. This acoustic armor is just one of several anti-bat defenses. As we saw in the previous chapter, more than half of moth species have ears that can hear bat sonar. Such ears offer a considerable advantage. Bats are listening for sounds that have traveled to a moth and back again, but moths only have to detect the same sounds after their initial outward journey, when

they’re much stronger. So while bats can hear small moths from no more than 9 yards away, moths can hear bats from 15 to 33 yards away. Many of them exploit this lead by executing dodges, loops, and power dives whenever they hear bat voices. Others talk back.

Tiger moths, a diverse group of 11,000 species, have a pair of drum-like organs on their flanks. These vibrate to produce ultrasonic clicks that seem to baffle bats, causing them to miss the moths.[*13] Sometimes these clicks are acoustic versions of warning colors: Many tiger moths are full of foul-tasting chemicals, and they click to tell bats that they aren’t worth eating. The clicks can also jam a bat’s sonar. In 2009, Aaron Corcoran and Jesse Barber found clear evidence that this happens by pitting big brown bats against *Bertholdia trigona*—a stunning American tiger moth that’s clad in the colors of a burning log. These moths have no chemical defenses and bats will eat them if they can. But the big browns frequently flubbed their attacks when they approached a clicking *Bertholdia,* even when the moths were tethered in place. The clicks overlapped with the bats’ echoes and messed with their ability to gauge distance. From their perspective, a target that was once sharply defined and precisely pinpointed would have suddenly blurred into a nebulous cloud with ambiguous position.[*14]

Other moths can cast illusions without incantations. Barber and Rubin have been breeding luna moths—unmistakable, palm-sized insects with a white body, blood-red legs, yellow antennae, and lime-green wings that end in a pair of long, streaming tails. When I open a cupboard in their lab, a few of these moths are just hanging calmly on the door, their empty chrysalises strewn across the shelves. In their adult form, they have no mouths and little time. In

a week, they'll be dead. Until then, "all they do is mate and evade bats," Barber says. They have no noxious chemicals. They can't make jamming clicks. They can't even hear bats coming because they have no ears. But those long tails that grow from their hindwings flap and spin behind them as they fly, producing echoes that distract echolocating bats into attacking an inessential body part. On average, a luna moth without tails is nine times more likely to be eaten than one whose tails are intact. "When I discovered that, I thought: This can't be real," Barber says. "Echolocation is such a remarkable sense. How can a spinning piece of membrane fool the bats? But we see it, and consistently."

I see it, too, on Barber's monitor. When a luna moth is released into the flight room, Zipper the bat attacks it, and misses. She turns, attacks again, tears off a mouthful of tail, and spits it out. As the unappetizing fragment drifts to the floor, Barber looks at me, grinning, and says, "I told you." The handlers bring out the moth: It's missing the left tail but is otherwise unharmed. They take a second luna inside, this time with its tails already removed. Zipper catches it almost immediately.[*15]

When I first looked at the luna moths, I thought their tails were like those of a peacock. But that was my visual bias leading me astray again. These moths find their mates through smell, and there's no evidence that the tails make them more attractive. They are meant not to delight the eyes of prospective mates but to fool the ears of prospective predators.

Donald Griffin once described bat echolocation as a "magic well" that, when uncovered, became an endless source of surprising discoveries. By understanding what bats can do, we can appreciate them for the biological marvels that they are instead of the unsavory creatures

they are reputed to be. We can better understand the creatures they hunt. And, as many scientists did after Griffin's work, we can look for other creatures that perceive the world through echoes.

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BATS AND DOLPHINS are about as different as two groups of mammals can be. Bats' front legs have stretched into wings, while dolphins' have flattened into flippers. Bat bodies are svelte and lightweight; dolphin frames are streamlined and blubbery. Bats cut paths through the open air; dolphins, the open seas. But both groups must move and forage through three-dimensional and often dark spaces. Both groups did so by evolving echolocation. And both groups surrendered their secrets to science in roughly the same way: Researchers first noticed that dolphins could avoid obstacles in the dark even when blindfolded, and then that they made and heard ultrasonic clicks.[*16] These observations were easier to interpret because, thanks to the pioneering work of Griffin and others, people already knew that echolocation existed. Researchers working with dolphins could test for a skill that just two decades earlier had seemed inconceivable.

Despite that advantage, research on dolphin sonar has progressed rather slowly, because the animals are not easy to work with. Their size alone is a problem. The smallest dolphin is around 40 times heavier than the biggest bat and requires a large saltwater tank instead of a small room. Dolphins are also smarter, harder to train, and more willful than bats: Kathy, a bottlenose dolphin who took part in a seminal early experiment, would agree to wear eye cups, but absolutely refused to don a sound-blocking mask that

covered her jaw and forehead. And while bats can be easily found in buildings and woods, dolphins live in a habitat so inaccessible that most humans only skim across its surface. So researchers who study dolphins have been mostly forced to work with animals that live either in aquariums or in naval facilities.

The U.S. Navy started training dolphins in the 1960s to rescue lost divers, find sunken equipment, and detect buried mines. In the 1970s, it invested heavily in echolocation research, not to understand how the dolphins themselves perceived the world but to improve military sonar by reverse-engineering the animals' superior capabilities. A field station in Hawaii's Kāneʻohe Bay became a hub of important research, led by psychologist Paul Nachtigall and electrical engineer Whitlow Au. "The dolphin was a black box, and my interest lay in defining the parameters of that box," Au tells me. "I used to get my kids very upset because they just wanted to hug the animals, and I would say that they were just test subjects." (I ask him if he still regards them that way after working with them for decades. He pauses, then says, "I see them as more complex test subjects.")

At Kāneʻohe Bay, where bottlenose dolphins like Heptuna, Sven, Ehiku, and Ekahi could swim in large, open-water pens, Au and his colleagues realized that dolphin sonar was even more impressive than anyone had guessed. Dolphins could discriminate between different objects based on shape, size, and material. They could distinguish between cylinders filled with water, alcohol, and glycerine. They could identify distant targets from the information in a single sonar pulse. They could reliably find items buried under several feet of sediment, and they could tell if those objects were made of brass or steel—feats that

no technological sonar can yet match. To date, “the only sonar that the Navy has that can detect buried mines in harbors is a dolphin,” Au says.

Dolphins belong to the group of whales known as odontocetes, or toothed whales.[*17] The other members of this group—porpoises, belugas, narwhals, sperm whales, and orcas—also echolocate, and many do so just as well as the familiar bottlenose. In 1987, Nachtigall’s team started working with a false killer whale—an 18-foot-long, black-skinned dolphin species known for being smart and sociable. The animal, Kina, could use her sonar to tell the difference between hollow metal cylinders that looked identical to the human eye and that differed in thickness by the width of a hair. On one memorable occasion, the team tested Kina using two cylinders that had been manufactured to the same specifications. To everyone’s confusion, Kina repeatedly indicated that the objects were different. When the team had the cylinders remeasured, they realized that one had a minuscule taper and was 0.6 millimeters wider at one end than the other. “It was incredible,” Nachtigall recalls. “We ordered them to be the same, the machinists said they were the same, and the animal said, ‘No, they’re different.’ And she was right.”

Dolphins can also echolocate on a concealed object and then recognize the same object visually—even on a television screen. This might seem like an obvious feat, but stop to consider what it involves. The animal isn’t just working out the object’s position but constructing a mental representation of that object, which can be translated to its other senses. And it’s doing that with *sound*—a stimulus that doesn’t naturally carry rich, three-dimensional information. If you heard a saxophone, you might recognize the instrument and work out where its music is coming

from, but good luck predicting its shape from sound alone. You could, however, *touch* a saxophone and get a solid impression of what it should look like. So it is with echolocation. This sense is often described as "seeing with sound," but you could just as easily think of it as "touching with sound." It's as if a dolphin is reaching out and squeezing its surroundings with phantasmal hands.

I'm not used to thinking about sound in this way. Outside my window, I can hear barking dogs, singing starlings, and chirping cicadas, all using sound to convey information to their audiences. But the air and water of this planet also abound with sounds that animals use to convey information to *themselves*—sound produced not for communication but for exploration. Other senses *can* be used in this way to explore, but echolocation is inherently exploratory. And it absolutely feels that way when deployed by an animal as inquisitive as a dolphin. "The animals aren't echolocating all the time, but any time you put a new object in with them, they'll buzz the crap out of it," Brian Branstetter, who started working with dolphins in Oahu in the 1990s, tells me. "And when I'm swimming with them, I can hear and feel their clicks: This animal is checking me out right now!"

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MUCH ABOUT DOLPHIN sonar is counterintuitive, including the way they produce it. At the top of the dolphin's head is the blowhole, which is equivalent to your nostrils. Just below the blowhole, in the animal's nasal passages, are two pairs of organs called phonic lips. The dolphin clicks by forcing air through those lips and making them vibrate. The sound then travels forward and is focused by a fatty organ

called the melon, which is what gives the dolphin its bulging brow. So while a bat's call begins in its throat and goes out through its mouth or nose, a dolphin's click begins in its nose and goes out through its forehead.

The sperm whale—the biggest odontocete of all—does something even stranger. Its titanic barrel of a nose can make up a third of its 52-foot body, and the phonic lips lie at the very front. When they vibrate, most of their sound goes *backward* through the whale's head. It passes through a fat-filled organ called the spermaceti (the contents of which whalers once prized), bounces off an air sac at the back of the head, and then moves forward through another fatty organ called the junk (which whalers deemed worthless). The sound that emerges from this absurd detour is the loudest in the animal world. At 236 decibels, it's basically an explosion. When scientists want to calibrate hydrophones to record sperm whale clicks, they throw cherry bombs into the water. The clicks are also focused into an extremely thin beam that's around 4 degrees wide. If a bottlenose dolphin perceives the ocean with a sonar flashlight, then a sperm whale fires a laser.[*18]

Odontocetes also intercept their own echoes in a bizarre way. In the 1960s, Ken Norris found a dolphin skeleton on a Mexican beach, and noticed that part of its lower jaw was so thin that it was almost translucent. This hollow stretch of bone is filled with the same fats that make up the melon. These "acoustic fats" are never burned for energy, no matter how starved a dolphin gets. Their purpose is to channel sound toward the inner ear. A dolphin is an echolocator that clicks with its nose and listens with its jaw.

Despite these weird traits, odontocetes use many of the same echolocating tricks as bats. When they need more information, they can speed up the pace of their clicks (as

in the terminal buzz) or group those clicks into packets (as in the strobe groups). They can adjust the sensitivity of their ears to dampen their own booming noises and to perceive the returning echoes at the same steady loudness. But odontocetes can also pull off feats of sonar that bats cannot. Sound behaves differently in water than in air. It travels faster and farther, so dolphin sonar operates over ranges no bat can manage.[*19] In an early experiment, Au showed that blindfolded dolphins could detect steel spheres at a distance of 110 yards, far enough that the team had to use binoculars to check that the targets were correctly positioned. The dolphins didn't need the help—and it later transpired that they were working under difficult conditions. Unbeknownst to anyone at the time, Kāneʻohe Bay was full of snapping shrimps, whose large claws fill the water with cacophonous pops. The dolphins were using sound to spot tennis balls across the length of a football field, in the underwater equivalent of a rock concert. Later studies showed that echolocating dolphins can detect targets from over 750 yards away.

Sound also interacts differently with objects underwater. Generally, sound waves reflect when they encounter a change in density. In the air, they ricochet off solid surfaces. But in water, they'll penetrate flesh (which mostly has a density similar to water's) and bounce off internal structures like bones and air pockets. While bats can only sense the outer shapes and textures of their targets, dolphins can peer *inside* theirs. If a dolphin echolocates on you, it will perceive your lungs and your skeleton. It can likely sense shrapnel in war veterans and fetuses in pregnant women. It can pick out the air-filled swim bladders that allow fish, their main prey, to control their buoyancy.[*20] It can almost certainly tell different species

apart based on the shape of those air bladders. And it can tell if a fish has something weird inside it, like a metal hook. In Hawaii, false killer whales often pluck tuna off fishing lines, and “they’ll know where the hook is inside that fish,” Aude Pacini, who studies these animals, tells me. “They can ‘see’ things that you and I would never consider unless we had an X-ray machine or an MRI scanner.”

This penetrating perception is so unusual that scientists have barely begun to consider its implications. The beaked whales, for example, are odontocetes that look dolphin-esque on the outside—but on the inside, their skulls bear a strange assortment of crests, ridges, and bumps, many of which are only found in males. Pavel Gol’din has suggested that these structures might be the equivalent of deer antlers—showy ornaments that are used to attract mates. Such ornaments would normally protrude from the body in a visible and conspicuous way, but that’s unnecessary for animals that are living medical scanners. With “internal antlers,” beaked whales could conceivably advertise to mates without needing to disrupt their sleek silhouettes.

This idea is hard to test because beaked whales are so elusive. They’ve never been kept in captivity, and, since they can dive for several hours on a single breath, many species are rarely seen. But despite their rarity, they have unexpectedly helped to address one of the biggest mysteries of odontocete sonar: how the animals use it in the wild. They certainly don’t care about the distances to steel spheres, or the width of brass cylinders—but what *do* they care about? How do they use their sonar to orient, hunt, or solve problems? Do diving sperm whales echolocate on the ocean floor to avoid literally hitting rock bottom? Do belugas and narwhals scan for distant breathing holes among Arctic ice? When dolphins swim into

a school of sardines, do they focus their perception on one fish, or all of them? Have any of them developed specialized strategies akin to CF bats detecting the fluttering wings of insects?

One way to find out is to use an acoustic tag—an underwater microphone on suction cups. When an odontocete surfaces for air, scientists can sidle over in a small boat, lean across with a long pole, and plonk the tag on the animal's flank. When it dives out of view, the device records both its clicks and the returning echoes. It captures a detailed journal of the animal's dive—everything it hears and everything it's *trying* to hear. Since 2003, one team of researchers has deployed acoustic tags on dense-beaked whales near the Canary Islands. These animals are silent when they first start to dive, perhaps to avoid attracting eavesdropping predators like orcas. Once they hit 400 meters, they start to click, and they'll typically find something to eat within minutes. These dark depths are apparently so rich in fish, crustaceans, and squid that the dense-beaked whale can afford to be picky. It might ensonify thousands of creatures but chase just a few dozen, selecting only the best morsels using the fine discriminatory abilities that Au and Nachtigall saw in their captive animals. The whales are so efficient that they only need about four hours of daily foraging to sustain their large bodies.

The dense-beaked whale's foraging style is only possible because underwater sonar has such a long range. A flying bat has less than a second to decide what to do about an insect-sized target that enters its sonar field, but a swimming odontocete has around 10 seconds to make its decision. A bat must always react. A whale can *plan*. In the introduction, I wrote about Malcolm MacIver's hypothesis

that when animals moved from the water to the land, the extra range of their vision enabled the evolution of more sophisticated minds, capable of planning. I wonder if the same hypothesis might work in reverse for echolocation.

Underwater sonar not only gives odontocetes a chance to deliberate but also allows them to coordinate. At night, spinner dolphins—a small and especially acrobatic species—capture prey by working together in teams of up to 28 individuals. Kelly Benoit-Bird and Whitlow Au showed that these hunts go through several distinct phases. First, the spinners patrol in a widely spaced line. Then, once they've found a group of fish or squid, they cluster together into a tight row and bulldoze their prey. The victims pile on top of each other, and the spinners encircle them to cut off any escapees. Pairs of dolphins then take turns darting into the circle from opposite ends, picking off the trapped animals. Throughout this sequence, the spinners switch formations seamlessly and simultaneously, and at those transition points they're especially likely to click. Are they shouting commands at each other? Are they echolocating on their teammates to track their positions? Could they be using each other's echoes to extend their own perceptions? Whatever the case, their coordinated, intelligent behavior is made possible by sonar—a sense that works over distances longer than a single dolphin. The pod might be spaced over 40 meters of water, but they're connected by sound and can act as one.

Daniel Kish envies them. "Waterborne sonar is sort of cheating," he tells me. "It gives you enormous advantages, having a medium like that. Air is not conducive to sonar, and yet it still works." And he should know. Kish isn't a bat researcher or a dolphin researcher. He doesn't study animal echolocation.

He echolocates.

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WHEN I TRY to click with my tongue, the sound has a muffled wetness to it, like a stone being thrown into a pond. When Daniel Kish clicks, the sound is sharper, crisper, and *much* louder. It is the sound of someone snapping their fingers, a sound that will make you snap to attention. It's a sound that Kish has been practicing for almost all of his life.

Born in 1966 with an aggressive form of eye cancer, Kish had his right eye removed at 7 months, and his left at 13 months. Shortly after he lost his second eye, he started clicking. At the age of two, he would routinely climb out of his crib and explore his house. One night, he crawled out of his bedroom window, dropped into a flower bed, and toddled around the backyard, clicking as he went. He remembers sensing the acoustically transparent chain-link fence, and the large house on the other side. He remembers climbing the fence, and then others like it, until a neighbor finally called the police, who brought him home. It wasn't till much later that Kish learned what echolocation was, or that he'd been doing it for about as long as he'd been walking.

Now in his 50s, Kish is still clicking and still using the rebounding echoes to perceive the world. I meet him at his house in Long Beach, California, where he lives by himself. Inside, he doesn't need to echolocate; he knows exactly where everything is. But when we go for a walk, the clicks come into play. Kish walks briskly and confidently, using a long cane to sense obstacles at ground level and echolocation to sense everything else. As we head down a residential street, he accurately narrates everything that

we pass. He can tell where each house begins and ends. He can locate porches and shrubbery. He knows where cars are parked along the road. An overgrown tree stretches a large branch across the sidewalk, and although my natural inclination is to warn Kish about it, I don't need to. He ducks, effortlessly. "If I wasn't echolocating, I'd have definitely bumped into that," he tells me.

Besides bats and odontocetes, several animals use a simpler form of echolocation. Small mammals might make ultrasonic clicks to find their way around, including various shrews, the solenodons of the Caribbean (which look like shrews), and the tenrecs of Madagascar (which look like hedgehogs). Certain fruit bats, which supposedly don't echolocate, create clicking noises with their wings and can use these to distinguish different textures. The oilbird, a large South American fruit-eater, makes audible clicks, perhaps to navigate the caves in which it roosts. Swiftlets, small insect-eating birds, might click for the same reason. And as Kish and many other people demonstrate, humans can navigate with echoes, too.[*21]

Human echolocation isn't as sophisticated as that of a bat or a dolphin, but as Kish likes to point out, those species have a several-million-year head start. And Kish does have a skill that Zipper the bat and Kina the false killer whale lack—language. He can give words to his experience. This should neatly solve Nagel's philosophical dilemma: We might never know what it's like to be a bat, but Kish can explain what it's like to be Kish. And yet he mostly describes his decidedly non-visual experiences in visual terms, even though he has no memory of what it was like to see. Glass panes and stone walls, which return sharp echoes, are "bright." Foliage and rough stones, which produce coarser echoes, are "dark." When Kish clicks, he

gets a series of “flashes,” like matches being repeatedly struck in the dark, each one briefly illuminating the space around him. “I live on a planet of seven and a half billion sighted people, so you tend to absorb the way people language their experience,” he tells me. And since he doesn’t know what it’s like to see, and I can’t fully appreciate his experience of sonar, there’s still a barrier between us that words can’t fully bridge. We’re both guessing at each other’s Umwelt, trying to use a vocabulary we share to describe experiences we don’t.

When fictional characters echolocate—think Toph Beifong from *Avatar: The Last Airbender* or Daredevil from Marvel comics[*22] —their abilities are usually portrayed as white concentric lines, spreading over a black background and delineating the edges of objects. Some of this is correct in spirit: Kish does get a sense of the three-dimensional space around him. But without the ultrasonic frequencies available to bats, the resolution of his sonar is lower. Edges aren’t clear-cut. Objects are defined less by their borders and more by their densities and textures. Those qualities “are like the color of echolocation,” Kish tells me. When I think about his sensory world, I imagine a watercolor sculpture popping into awareness with every click. Objects are represented by splotches whose outlines are indistinct, and whose “hues” represent different textures and densities.[*23] A tree, Kish tells me on our walk, sounds like a solid vertical post that is topped by a larger, softer blob. A wooden fence will sound softer than a wrought iron one, and both will sound more solid than a chain-link fence. On his street the crisp sound of the hardwood door sandwiched between the fuzzier sounds of the surrounding bushes tells him when he’s back at his house. Occasionally, unexpected combinations of texture confuse him. We pass a car that’s

parked in an incompletely paved driveway, with concrete beneath its tires but turf beneath its undercarriage. Kish pauses as we pass it, and asks me if someone has parked on their lawn.

For Kish, echolocation is freedom. He walks around the city, rides his bike, and goes on solo hikes. And he's not unusual in that: Since at least 1749, there have been anecdotes about blind people who could walk unassisted through crowded streets, or (in later centuries) cycle around obstacles and skate in busy rinks. Humans had been echolocating for hundreds of years before anyone had even defined echolocation as a concept. The ability was historically described as "facial vision" or an "obstacle sense." As with bats, researchers believed that practitioners were sensing subtle changes in airflow over their skin. The practitioners, meanwhile, were mostly mystified about the nature of their perceptions.[*24]

Take Michael Supa. A psychology student, Supa had been blind since childhood. He would regularly detect distant obstacles in his daily life but couldn't explain how he did it. He suspected that hearing was involved, since he'd often snap his fingers or click his heels to find his way around. In the 1940s, he tested that idea. In a large hall, Supa showed that he and other students—one also blind, and two sighted but blindfolded—could use their hearing to detect a large Masonite screen. This worked best if they wore shoes on a hardwood floor, less well if they wore socks on carpet, and not at all if their ears were plugged. In an even more dramatic demonstration, Supa asked a blindfolded experimenter to carry a microphone and walk toward the screen. Sitting in a nearby soundproofed room and listening through earphones, Supa could work out where the screen was and tell his colleague when to stop.

By coincidence, these experiments were taking place at roughly the same time Griffin and Galambos were working with bats. Supa referenced the bat studies when he published his results in early 1944, and when Griffin coined the term *echolocation* later that year, he was describing the skills of both bats *and blind people,* citing Supa. But while bat sonar became a common part of popular knowledge, human echolocation did not. To this day, Kish will meet echolocation researchers "who have no idea that humans can echolocate," he says. "Human biosonar has been dismissed as too crude to be worthy of study." I suspect that's because blindness still carries so much stigma. To be blind to something is to be oblivious to it. To have a blind spot is to have a zone of ignorance. To lack vision is to lack creativity. These ableist phrases equate lack of sight with lack of awareness. And yet blind people are profoundly aware of their surroundings.[*25]

With echolocation, Kish can do things that sighted people cannot, like perceive objects behind him, around corners, or through walls. But some tasks that are easy with vision are very hard through sonar. Large objects in the background will mask the echoes of smaller objects in the foreground. Just as bats struggle to detect insects on leaves, Kish and other echolocators struggle to locate objects on tabletops—a task that, somewhat annoyingly, they're often asked to try. "You're trying to discriminate a Kleenex box, a stapler, or some other piece of rubbish off of this massive target," he says. "It's like reading white text on white." Similarly, if a person is standing right up against a wall, Kish will sometimes miss them entirely if he's clicking from the wrong angle. Surfaces that slope up away from him are easier to detect than those sloping down. Angled objects are easier than curved ones. Harder objects

are easier than soft ones. In one memorable test involving a German TV show, Kish realized that his echolocation couldn’t distinguish between a champagne bottle and a stuffed toy. The curved and tapered bottle reflected his clicks in too many directions, while the fluffy toy absorbed them. Ultimately, neither reflected enough energy to produce a clear sense of shape or texture, “and so my brain equated the two,” Kish says. “I just couldn’t tell them apart.”

In practice, these challenges aren’t actually that challenging because Kish almost never relies on echolocation alone. When moving around his house, he remembers where he placed his stuff. When he’s walking around his neighborhood, he remembers the layout of streets. He’ll use other senses, including passive hearing and touch. If he’s walking down a road, he can hear oncoming vehicles before he can echolocate them. If he’s standing on a sidewalk, his sonar can’t tell him where the edge of the curb is, but his cane easily can. Years ago, when he was a little younger and bolder, he and other blind friends would go mountain biking. A sighted friend would lead the way, and the group would follow. They fixed zip ties to the backs of their bikes so that the rattling of plastic against metal would tell them where their fellow cyclists were. They chose bikes with hard suspensions to better feel the terrain. “And then, yeah, a heck of a lot of clicking,” Kish says.

In 2000, Kish founded a nonprofit called World Access for the Blind to teach other blind people to echolocate. He and his fellow instructors, who are also blind, have trained thousands of students in dozens of countries. Echolocation is still a niche skill and one that’s frowned upon by some parts of the blind community for being socially

inappropriate, counter to tradition, or too hard for all but a prodigious few. Kish disagrees. Echolocation could be more common if only more echolocators were allowed to teach. Kish himself was the first fully blind person in the United States to be certified as an orientation and mobility specialist—someone who helps blind people learn to get around. “There is active resistance to blind people teaching other blind people how to be blind,” he tells me. “It’s a sort of reinforced custodialism.” Kish says that many blind children will naturally try to explore through noise. If they’re not using their tongues, they might snap their fingers or stomp their feet. But parents often see these behaviors as weird or antisocial, and put a stop to them before they can bloom into a sophisticated sonar sense. Kish’s parents never did that. They allowed him to click. They bought him a bicycle. “They regarded my blindness as very much incidental and supported my freedom to move, to discover, to learn how to relate to my environment,” he says. That freedom eventually changed the nature of his brain.

Neuroscientist Lore Thaler has worked with Kish since 2009. Using brain scanners, she has shown that when he and other echolocators hear echoes, parts of their visual cortex—the region that normally deals with vision—are highly active. When sighted people hear the same stimuli, those same brain regions lie dormant. This doesn’t mean Kish is “seeing” echoes. It’s more that he’s organizing the information from those echoes to build a spatial map of his surroundings—a task that vision naturally excels at. Without vision, the brain can still construct similar maps by repurposing the so-called visual cortex into an echo-processing cortex.[*26] So Kish can hear where things are relative to him, but he also knows where they are relative

to each other. This ability likely explains many of the more impressive things that he does, from hiking to biking. His memory, his cane, and his other senses give him information, but his clicks ground that information in space. “His ability to understand space is fundamentally better than most people who have no vision from an early age,” Thaler tells me. And that ability comes from a lifetime of practice and active exploration.

Earlier in this chapter, when talking about dolphins, I wrote that echolocation could just as easily be described as “touching with sound.” That’s also roughly how Kish thinks about it. “It feels like an extension of my sense of touch,” he says. It’s purposeful and probing. Like a bat, Kish is forcing the world to reveal itself. In some ways, all senses can be like this. A raptor can look around with its eyes, a snake can flick its tongue to collect scent, a star-nosed mole can press its starry nose upon the walls of its burrow, a rat can whisk with its whiskers, and a fire-seeking beetle can sensitize its infrared detectors by flapping its wings. But an echolocating bat, dolphin, or human is *always* exploring, by default. So far, echolocation is the only sense we’ve met that works in this permanently active way.

There is another.

SKIP NOTES

*1 For over a century, scholars claimed instead that bats feel their way through the night by sensing air currents playing along their wings. In 1912, Hiram Maxim (hot off inventing a fully automatic machine gun) modified this idea by suggesting that bats feel the reflections of low-frequency sounds produced by their wingbeats. It wasn’t until 1920 that the physiologist Hamilton Hartridge correctly speculated that they were listening for echoes from high-frequency sounds. This was the idea that Griffin heard.

*2 The Dutch scientist Sven Dijkgraaf had being doing similar studies. But with Germany occupying the Netherlands and war disrupting scientific communication across the Atlantic, Dijkgraaf had no idea what Griffin and Galambos were up to, and didn't have access to an ultrasonic detector.

*3 The origins of echolocation are still unclear, because the origins of bats themselves are unclear. Bat skeletons tend to be small and delicate, which means they leave behind few fossils that might hint at their ancestry. And modern bats, despite their variety, are more physically similar than they are different, which makes it hard to work out how different groups are related. For these reasons, there's still vigorous debate about when bats first started to echolocate, whether they could already fly at that point, whether they initially used the ability to avoid obstacles or find prey, and how many times that ability evolved. Traditionally, the bat family tree has two main branches—one containing the smaller echolocating species, and another containing the larger fruit bats that (with one exception) do not echolocate. We now know this is wrong. The most recent tree, which includes genetic data, shifts several of the smaller bats, including horseshoes and false vampires, over to the fruit bat branch. That's huge news in the world of bat academia. If correct, it means either that echolocation evolved once in the common ancestor of all bats and was subsequently lost in the fruit bats or that it evolved on two separate occasions.

*4 The big brown bat actually produces a forked sonar beam with two horns—one pointing ahead and another pointing downward. The bat might use the forward horn to scan for insects and obstacles and the downward one to keep track of its altitude. This is reminiscent of the eyes of birds of prey, which have two foveae, one for scanning the horizon and another for tracking prey.

*5 The bat's flashlight, however, pulses on and off several times a second, offering a series of stroboscopic snapshots. It seems likely that the bat's brain knits these snapshots into something smooth and continuous, much as our brains do when we watch a movie where static frames appear in quick succession.

*6 This is another reason why bats keep their calls short: Since they compute distance from time, a shorter call provides a more precise estimate of range.

*7 If that scene is especially complex, big brown bats can get even more detail by shifting the frequencies of the individual calls within the strobe groups, so that each is lower than the last. Several species do this kind of "frequency-hopping": The chestnut sac-winged bat produces triplets of ascending frequencies, and is also known as the do-re-mi bat.

*8 When bats want to communicate with each other, they tend to make types of calls very different from the ones they use as sonar. The difference between communication and echolocation isn't clear-cut, though. Some bats can recognize the sonar calls of familiar individuals and will eavesdrop on each other's feeding buzzes. The greater bulldog bat can also modify its sonar call into a message: It'll add a deep warning honk at the end of the pulse if it's about to hit another bat.

*9 In *Listening in the Dark,* Donald Griffin devoted an entire section to "bumbling bats." In it, he noted that the miraculous feats for which these animals are rhapsodized, like flying through a curtain of thin wires, are only performed by "the most alert and wide-awake" individuals. Under some conditions, Griffin wrote, bats "are quite clumsy and they sometimes blunder headlong into obstacles which they dodge without the slightest difficulty at other times. Perhaps I have become a trifle sensitive about this point for whenever a bat is seen to bump into anything I am very likely to hear about it, often in slightly accusing tones."

*10 In practice, many bats use a mix of CF and FM calls. When FM bats like big browns are searching in open air, they produce CF-like pulses. Meanwhile, CF bats will add a brief frequency sweep at the end of their pulses to better judge the distance to their prey.

*11 Researchers have called this sensitive band the acoustic fovea, after the part of the retina where visual acuity is sharpest. It's a decent analogy, but also a little off. The fovea is a region of physical space where vision is sharpest, but the acoustic fovea describes a region of informational space where the bat's hearing is most acute. It's more like walking around with eyes that are inordinately good at seeing a particular shade of green.

*12 In this way, CF bats use the potential problem of the Doppler effect to their advantage. FM bats must keep their calls short to avoid overlaps with the returning echo. But CF bats separate their calls and echoes in frequency rather than time. Thanks to the Doppler effect, the echoes are usually higher in pitch than the calls, and more obvious to the bat's finely tuned ears. That's why their calls can afford to be long—long enough to return an acoustic glint and reveal the presence of fluttering prey.

*13 Dorothy Dunning and Kenneth Roeder first demonstrated this in 1965, showing that the clicks can stop little brown bats from successfully catching their prey. The duo had trained the bats to catch mealworms that were shot into the air—a task they did almost perfectly. But when they heard recordings of tiger moth clicks, they usually missed.

*14 Around half of hawkmoths—another major group of around 1,500 species—can also jam bats. But unlike the tiger moths, hawkmoths produce their confounding clicks by rubbing their genitals together. They seem to have evolved this ability on three separate occasions, with each group repurposing a different section of their sex organs into bat-befuddling instruments. But bats, in turn, have evolved counters to moth defenses. At least two species—the barbastelle of Europe and the Townsend's big-eared bat of North America—make very quiet calls that allow them to sneak up on moths unnoticed. With their stealthy whispers, they can get so close that their prey don't have time to either dodge or jam.

*15 It's still unclear how the tails work. The echoes they produce might fuse with those from the moth's body, tricking the bat into thinking that it's hunting a much larger animal that's closer to its jaws. Alternatively, they might sound like entirely separate targets, or more conspicuous ones. Whatever the case, they work. Moths have evolved long tails on at least four separate occasions, and some of these can be twice as long as the rest of the insects' wings.

*16 In the 1950s, Arthur McBride wondered if dolphins, porpoises, and other toothed whales might share the same ability. After watching porpoises evading fishing nets in the dark, he was reminded of bats. Ken Norris carried out a particularly illuminating experiment in 1959 when he trained a bottlenose dolphin named Kathy to wear latex suction cups over her eyes. Without vision, Kathy could still find floating pieces of fish by releasing volleys of rapid clicks, or swim through a maze of vertical pipes just like the bats flew through curtains of wires. If anything, she was more agile. While Griffin's bats would often brush the wires with their wingtips, Kathy only ever once bumped a pipe in two months of testing—and even then, she seemed to do it on purpose.

*17 A brief note on terminology: Dolphins, whales, and their relatives all belong to the group known as the cetaceans, which are colloquially just known as whales. There are two main groups: baleen whales (mysticetes) and toothed whales (odontocetes). Dolphins are one group within the toothed whales, and they include killer whales and pilot whales. Dolphins and porpoises are different kinds of toothed whales, but the two terms have sometimes been used interchangeably; some early echolocation papers refer to "bottlenose porpoises." So, to recap, dolphins are whales, killer whales are dolphins, and porpoises are not dolphins, except when they are.

*18 Why are sperm whale calls so ridiculously loud? It might be so that they can detect the ocean floor when they dive after prey. With a top speed of 9 miles per hour and bodies that can weigh 40 tons, it takes some time for them

to stop. It might also be that they mainly feed on squid, whose soft bodies are harder to detect through sonar.

*19 It helps that dolphin sonar pulses tend to be shorter, louder, and more focused than those of bats. A bottlenose's click can contain 40,000 times more energy than a big brown's call.

*20 Most fish cannot hear very high frequencies, but there are exceptions. The American shad, the Gulf menhaden, and a few other species have evolved ears that can hear dolphin sonar, just as some moths can hear the cries of bats.

*21 Griffin predicted that owls might echolocate—and they don't. After the discovery of echolocation in dolphins, some scientists suspected that seals might share the same skill—and they don't. Why don't seals echolocate? One reason might be that they are amphibious. A dolphin is completely tied to the water, but seals and sea lions must venture out onto land, and it is very hard to develop a sonar system that works in both worlds. Instead of sonar, they rely on their eyes, their ears, and the incredible wake-sensing whiskers that we met in Chapter 6. Notably, every species that's known to echolocate is warm-blooded, and none of the countless invertebrates are known to use this ability. Is there some reason for that, or have scientists just not looked hard enough?

*22 Toph's skill is more like the seismic senses of treehoppers, while Daredevil doesn't have to make sound to use his "radar sense," so neither is true echolocation. Also, Kish and other human echolocators are often described as "real-life Batmen," which is an appropriate comparison since bats echolocate, but also an inappropriate one, since Batman does not.

*23 In the *Daredevil* series that appeared on Netflix, the character's radar sense is portrayed differently than in the comics. He describes it as a "world on fire," with one character appearing as a red smudge against a cooler backdrop. This, to me, comes a little closer to capturing the textural detail of actual human echolocation.

*24 Kish tells me that it took him a long time to articulate how his clicks were working; he just knew they worked.

*25 Kish says that most blind people use at least a rudimentary version of echolocation that's enough for them to avoid walls or walk down corridors. He describes this as "monochromatic"—a basic awareness of what's around. Even sighted people can quickly learn to do this. What distinguishes the most

proficient echolocators is their ability to make out finer details at greater distances with less effort. Our sense of hearing, like all our senses, is built to extract the signal from the noise—speech over background noises, our names at a cocktail party, a siren across a street. In the process, we downplay ambient sounds, including echoes. “If you’re echolocating, you almost have to invert that filter because those ambiances and reverberations—sounds that we would normally dismiss as background—are now actually the elements needing to be discriminated,” Kish tells me. For him, signals are embedded in what most other ears would hear as noise. That’s why it takes so much practice.

*26 One might ask whether the “visual cortex” is accurately named, and whether it’s really a “spatial mapping cortex that’s usually but not always connected to the eyes.”

10.

Living Batteries

Electric Fields

I AM IN ERIC FORTUNE'S LAB in Newark, New Jersey, staring into an aquarium tank that houses an electric catfish, one of many fish that can generate electricity. Stout and russet brown, it looks like a sweet potato with fins. Fortune has named it Blubby. Its shock, he assures me, is punchy but no worse than licking a battery. "If you want to be electrocuted, you can be," he says. Despite a niggling concern that he does this to haze visiting journalists, I stick my hand in the tank. Blubby doesn't flinch. I quickly do. As the fish's discharge forces my muscles to contract, I reflexively yank my arm out of the tank, splashing water over my notepad. My fingers tingle for an hour afterward. "That's about 90 volts," Fortune says. "I'm glad you had that experience."

Around 350 species of fish can produce their own electricity, and humans have known about their ability since long before anyone knew what electricity was. Around 5,000 years ago, the Egyptians carved depictions of Blubby's ancestors onto tombs. The Greeks and Romans wrote about the torpedo ray's "benumbing" power—a strange force that could kill small fish, run up a spear into the arm of the person fishing, and treat everything from headaches to hemorrhoids.[*1] The true nature of these discharges only became clearer in the seventeenth and eighteenth centuries, when scientists defined electricity as a physical entity and realized that animals can produce it.

The study of electric fish then became entwined with the study of electricity itself. These animals inspired the design of the first synthetic battery. They fueled the discovery that muscles and nerves in all animals run on minute currents. Indeed, electric fish evolved their unique powers by modifying their own muscles or nerves into special electric organs. These organs consist of cells called electrocytes, stacked together like towers of pancakes flipped on their sides. By controlling the flow of charged particles called ions through an electrocyte, a fish can create a small voltage across it. And by lining these cells up and triggering them together, it can combine the minuscule voltages into substantial ones.

None do this better than electric eels. Their electric organs take up most of their 7-foot-long bodies, and contain around 100 stacks of between 5,000 and 10,000 electrocytes. The most powerful of the three electric eel species can discharge 860 volts—enough to incapacitate a horse.[*2] It uses its brutal powers with sinister finesse. When hunting small fish and invertebrates, it delivers pulses that force the muscles of its prey to twitch, giving away its position. Stronger pulses then cause those same muscles to lock, paralyzing the victim. The electric organ is both remote control and Taser, allowing the eel to commandeer the bodies of other animals from afar.[*3]

Most electric fish are more benign. Their discharges are so faint that they can barely be felt by humans. Known as weakly electric fish, they belong to two main groups—the elephantfishes (mormyroids) of Africa, and the knifefishes (gymnotiforms) of South America. (The electric eel, despite its name, is actually a knifefish—and the only member of the order that produces strong discharges.) Weakly electric fish perplexed nineteenth-century scientists, including

Charles Darwin. He correctly theorized that the strong electric organs of electric eels and torpedo rays must have evolved from normal muscle via a weaker, intermediate stage. But weaker electric organs wouldn't have evolved at all if they weren't of some use. And if they are too feeble for offense or defense, what were they for? " It is impossible to conceive by what steps these wondrous organs have been produced," Darwin wrote in 1859, in his landmark opus *The Origin of Species.* "But this is not surprising, for we do not even know of what use they are."

Darwin can rest easy. After 160 years of research, it is clear that the knifefishes and elephantfishes use their electric fields to sense their surroundings, and even to communicate with each other. Electricity is to them what echoes are to bats, smells are to dogs, and light is to humans—the core of their Umwelt.

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MALCOLM MACIVER TELLS me to listen and then dips an electrode into a small tank. The device detects an electric field oscillating 900 times a second. It converts that field into a sound that emerges from a nearby speaker as a haunting soprano note, roughly two octaves above middle C. This is how we hear the tank's silent resident—a black ghost knifefish.[*4]

The black ghost is as long as my hand. Its skin is the color of dark chocolate, and its blade-like body tapers from a broad head toward a pointed tail. A single ribbon-like fin runs along its underside, undulating constantly. This fin propels the fish in every possible direction with uncanny agility. At first, the fish hovers in the middle of a cylinder at the bottom of the tank. It darts out and, with equal ease,

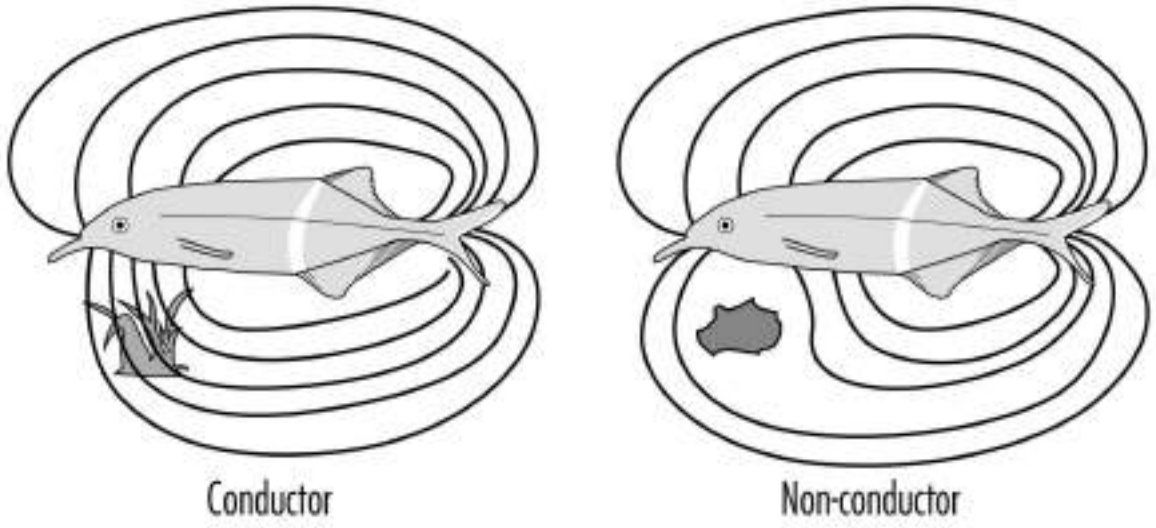
reverses. It turns upside down. It zips backward, and just before it collides with the back wall of the tank it curves its body and slides up the wall tail-first. “That’s how Hans Lissmann worked out what was happening,” MacIver tells me.

Hans Lissmann was a Ukrainian-born zoologist who studied with Jakob von Uexküll, the man who coined the Umwelt concept. After surviving two world wars, Lissmann ended up in Britain. During a fateful visit to the London Zoo, he watched an African knifefish deftly avoiding obstacles while reversing around its tank. In a neighboring display, he saw an electric eel perform the same feat, and wondered if both fish were somehow using electricity to sense the objects around them. He soon got the chance to test this idea when a friend gave him a knifefish as a wedding present.[*5]

In 1951, Lissmann used electrodes to confirm that the animal produced a continuous electric field from the organ in its tail. He realized that objects would distort this field if they were either more or less electrically conductive than water. And by sensing those distortions, a knifefish could conceivably detect whatever produced them. Lissmann and his colleague Ken Machin probed the limits of this ability and were astonished. After some training, a knifefish could distinguish between a clay pot that contained an insulating glass rod and an identical pot that was empty. It could even discriminate between different blends of water that varied only in their purity. It clearly had an electric sense unlike anything that humans possess. Lissmann and Machin published their results in 1958, marking the second time in as many decades that a strange new sense had been formally documented. Just 14 years earlier, Donald Griffin had coined the term *echolocation* to describe the sonar of

bats. Fittingly, the equally strange ability of electric fish became known as *active electrolocation*. (Why the “active” qualifier? We’ll find out later.)

The electric organ in the fish’s tail is like a small battery. When it switches on, it creates an electric field that envelops the animal. Current flows through the water from one end of the electric organ to the other. Nearby conductors, like animals (whose cells are essentially bags of salty liquid), increase the flow of that current. Insulators, like rocks, reduce it. These changes affect the voltage on different parts of the fish’s skin. The fish can detect these differences using sensory cells called electroreceptors. The black ghost knifefish has 14,000 of these scattered over its body, and it uses them to work out the position, size, shape, and distance of the objects around it. Just as sighted people create images of the world from patterns of light shining onto their retinas, an electric fish creates electric images of its surroundings from patterns of voltage dancing across its skin. Conductors shine brightly upon it. Insulators cast electric shadows.



An elephantfish produces its own electric field, which is distorted by conducting and nonconducting objects in its environment.

Visual terms like *image* and *shadow* are useful when describing such an alien and unfamiliar sense. But electrolocation is very different from vision. The fish that possess this sense care about physical qualities that many other creatures never notice, while ignoring traits that seem (quite literally) blindingly obvious. When Eric Fortune collects electric fish from the wild, he can shine a flashlight upon them to no effect. But once he reaches into the water with a net, “if there is any exposed metal, you can’t catch them,” he tells me. Conductive metal is more of a beacon to them than actual light.

They are also sensitive to salinity. In the Amazon basin, where many knifefishes live, heavy rainfall regularly flushes ions out of the water. Against this desalinated background, the conductive, salt-filled bodies of other animals pop out to fish that can electrolocate. But in North American tap water, which is relatively laden with ions, those same animals would blend into the background. MacIver’s lab is

based in Evanston, Illinois; he tells me that if he were to release his captive black ghost knifefish into a local river, it would probably struggle to detect any food, and die. As it is, he adjusts the ion levels in the fish's tank to mimic its natural environment, using a recipe handed down between generations of electric fish researchers.[*6] The black ghost is far from the Amazon, but perhaps its water might at least feel like home.[*7]

Active electrolocation is similar to echolocation in that it always involves effort. In other senses, activity is optional—noses can sniff, eyes can dart, and hands can stroke, but these organs can also wait for stimuli to come to them. Echolocating bats and electrolocating fish cannot wait. Both must create the stimuli that they then detect. But there is one key difference between these senses: *Electric fields do not travel*. Almost all other senses depend on stimuli that move. Odor molecules, sound waves, surface vibrations, and even light must all make journeys from sources to receivers. But whenever a knifefish fires its electric organ, electric fields immediately materialize around it. It doesn't have to wait, as a bat must, for a returning echo. Electrolocation is an instantaneous sense.

It is also omnidirectional. Since an electric fish's field extends in every direction, so does its awareness. That's why the black ghost knifefish that I saw, and the African knifefish that entranced Hans Lissmann, could avoid obstacles behind them. These fish have been filmed swimming backward for meters at a time. "Imagine walking backward for five meters—you just wouldn't," Fortune tells me. "Electric fish can."

Their wraparound sensing comes with a significant catch. Electric fields rapidly weaken the farther they are from their source, so electrolocation only works at very

short ranges. The black ghost knifefish eats water fleas that are just a few millimeters long, and can sense these tiny morsels as long as they're within roughly an inch of its body. Beyond that, the water fleas are undetectable, and even larger objects are indistinct. "I think of the fish as being in heavy fog all the time," MacIver tells me. The black ghost can extend the range of its awareness by generating a stronger electric field, and it does this every night when it starts to forage. But extra effort can only go so far. To double the range of its electric sense, it would have to expend eight times more energy—and it already spends a quarter of its total calories on generating its fields.[*8]

These limitations help to explain why many of these fish are so agile. With their awareness mostly confined to a small sensory bubble, they must quickly react to whatever they detect. By the time they sense an obstacle, they have to brake suddenly or swerve quickly. When they detect something edible, they might have already passed it, and must backtrack. MacIver shows me a video in which a black ghost does exactly that. It initially swims past a water flea, but then reverses until its head is close enough to grab the morsel. If it did a U-turn, the flea would have left the range of its electric sense and been lost. Instead, it pulled off a parallel-parking maneuver and kept its prey inside its sensory bubble. This is another example of the intimate connections between an animal's body and its sensory systems. The black ghost knifefish's agility wouldn't be much use without its wraparound electric sense, and its sense would be of little use if the fish weren't so agile.

The omnidirectional nature of electrolocation means that of all the senses we have encountered so far, it is perhaps

most similar to touch. “We don’t find it weird that we can sense touch all over our body,” MacIver says. “Now imagine that’s extended out a little bit. That’s what the electric sense is like, I think. But who knows what it’s like for the fish?” Bruce Carlson, who also studies electric fish, imagines that the fish might feel a kind of pressure on its skin. Conductors and insulators might feel different, just as hot and cold objects or rough and smooth ones do to our fingers. “I can imagine that if I swam past a metal ball, I’d get a small cool sensation like a piece of ice rolling down one side of my body,” he tells me. This is speculative, of course, but electric fish really do behave as if they’re touching their surroundings from a distance. They’ll investigate objects by shimmying back and forth next to them, just like humans running their fingertips over a surface. They’ll wrap their bodies around mystery items to get clues about their shape, just as we might grasp unfamiliar things in our hands. Daniel Kish said that he thought about echolocation as a tactile sense: He uses sound to extend his sense of touch and to purposefully probe his world. Electric fish use electric fields in the same way.[*9]

If all this sounds eerily familiar, think back to how swimming fish create fields of flowing water around their bodies. Objects around them distort those flow fields, and fish can use their lateral lines to sense those distortions. Sven Dijkgraaf called this “touch at a distance,” which is exactly what electrolocating fish are doing, only using electric currents instead of water currents. This resemblance isn’t a coincidence. The electric sense *evolved from the lateral line.* Electroreceptors grow from the same embryonic tissues that create the lateral line, and both sense organs contain the same kinds of sensory hair cells

(which are also found in your inner ear).[*10] The electric sense really is a modified form of touch, repurposed for sensing electric fields instead of flowing water.[*11]

But if the lateral line already existed, why evolve electrolocation on top of it? It might be that electric fields are more reliable than almost any other stimulus. They aren't distorted by turbulence, so electric fish can thrive in fast-flowing rivers, where torrents and eddies befuddle the lateral line. Electric fields aren't obscured by darkness or murkiness, so electric fish can stay active in turbid waters and nighttime hours. Electric fields aren't blocked by barriers as light and smells are, so electric fish can sense through solid objects to detect hidden treasures. Indeed, it's very hard to hide from these animals. They are sensitive not only to conductance, which is an object's ability to carry a current, but also to capacitance, which is its ability to store a charge. And in natural environments, "capacitance is a mark of the living," MacIver says. Prey animals can freeze, hide, and hush to fool predators that rely on vision and hearing. But stillness, concealment, and silence don't work against electrolocation. To an electric fish, all that's alive stands out against all that isn't. And other electric fish stand out most of all.

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SHORTLY AFTER THE 9/11 attacks, Eric Fortune got a call from the dean of his university. One of Fortune's colleagues was part of the Air Force Reserve and had been called for duty. The man had been scheduled to go to Ecuador on a field trip, and his spot was now open. It was Fortune's if he wanted it—and he did.

Fortune ended up in the middle of the Amazon rainforest, in a lodge overlooking an oxbow lake. One evening, while bats gleaned insects off the lake's surface and huge spiders fished by its edge, Fortune walked onto a pier, connected an electrode to an amplifier, and lowered it into the water. Immediately, he heard a familiar sound—the distinctive hum of *Eigenmannia,* the glass knifefish. These are among the most widely studied electric fish, and Fortune had worked with them before. But he had only ever listened to a few dozen in his laboratory. Standing on that pier, he heard what must have been hundreds. He couldn't see any of them, but he knew there was a bustling electric world below his feet. "It was a moment I can still close my eyes and go back to," he tells me. "It was the most amazing experience I've ever had, and I'm so sad I'm not there right now."

For decades, scientists have studied electric fish in laboratories. It's so easy to record, tweak, and play back the discharges of these animals that they have become mainstays of research in neuroscience and animal behavior. Researchers can, for example, play signals that mimic something moving against a fish's body, and watch how it responds. They've been doing this since the 1960s, creating virtual-reality worlds for electric fish. But the animals' actual worlds are still mysterious because they are very hard to study in the wild. Both the African elephantfishes and the South American knifefishes tend to live within dense rainforests, in murky rivers, and amid tangled underwater vegetation. In some places, they are easily the most common fish around. But you'd never be able to tell unless, as Fortune did, you dropped an electrode into the water and converted their electric chorus into audible sounds.

Such electrodes have improved over time, from simple ones you can buy at a local store[*12] to complex grids that can determine the position of every individual within a shoal. These devices have revealed that fish use electric fields not just to sense their environment but also to communicate. They court mates, claim territory, and settle fights with electric signals in the same way other animals might use colors or songs.

Electric fields are great for communication because they don't get distorted in the way that sounds do. They aren't absorbed by obstacles. They don't echo. They don't even travel; instead, they instantly appear in the space between the fish that generates them and the one that detects them.[*13] This means that electric fish can encode information within fine-grained features of their discharges, without any risk that their messages will be corrupted. In the chapter on hearing, we saw that zebra finches pay attention to the temporal fine structure of their songs—that is, how notes change from one thousandth of a second to the next. Electric fish do the same with their electric discharges, but they're sensitive to *millionths* of a second. They can cram information into even simple signals.

Some species of electric fish turn their fields on and off to produce strong staccato pulses, like drumbeats. The shape of these pulses—their duration and how their voltage changes over time—contains information about the animal's species, sex, status, and sometimes identity. Over short timescales, every individual produces the same pulses again and again: "I like to think of it as the sound of your voice," says Bruce Carlson. The timing of the pulses, however, can vary considerably. If the shape of the pulse conveys identity, the *timing* of the pulses conveys meaning.

One rhythm might be as attractive as birdsong; another could be as threatening as a snarl.

Other species, like the black ghost and glass knifefishes, produce pulses in such quick succession that they blend into a single, continuous wave, like an endless violin note. The frequencies of these waves differ between species (and sometimes sexes), and the fish control their timing with unbelievable precision. The neuroscientist Ted Bullock once showed that the black ghost's electric field usually oscillates once every 0.001 seconds, with an error of just 0.00000014 seconds. It's one of the most accurate clocks in the natural world, and was almost too precise for Bullock's instruments to measure.[*14] By minutely changing the frequencies of these carefully controlled signals, wave-type electric fish can send messages. By briefly and sharply increasing the frequency of their signals, they can produce "chirps," which are "short and abrupt during aggressive encounters but assume a softer and more raspy quality during courtship," Mary Hagedorn and Walter Heiligenberg once wrote.[*15]

Such messages don't carry far, but electrocommunication is less limited by range than active electrolocation. When electrolocating, a fish can only extend the range of its sense by producing a stronger electric field, which, at some point, just takes too much energy. But when "listening" to another fish's electric signals, it doesn't need to generate a field at all. It only needs more sensitive electroreceptors, and those are easier to evolve. A fish might only be able to sense prey an inch around its body, but it can detect the signals of other electric fish from a few feet or more away. Its own kind shine out in the perceptual fog that Malcolm MacIver imagined.

Electrocommunication is especially important for one group of elephantfishes called the mormyrins, which have taken the skill to extreme heights. All elephantfishes have a unique type of supersensitive electroreceptor called the knollenorgan, which is not used for electrolocation and is tuned only to the electric signals from other fish. The mormyrins have altered these special receptors even further, retooling them to detect subtle features of electric signals that other elephantfishes can't spot. According to Bruce Carlson, who discovered these differences, it's as if the mormyrins have the electric version of color vision, while other elephantfishes are stuck with monochrome.

Carlson suspects that these changes were triggered by a shift in the fishes' social lives. The elephantfishes with simpler knollenorgans live in large schools and open water. They only need to know if others are around and where they are. The mormyrins, however, are mostly solitary, territorial, and found at the bottom of dark rivers. "If they detect another fish, they want to know exactly where that fish is and *who* it is," Carlson says. "A potential rival? A mate? Another species they don't care about?" This need to know about others has changed their electric sense. It has also altered the course of their evolution in at least two important ways.

First, mormyrins are very diverse. Since they can sense tiny variations in each other's electric signals, they can also develop sexual preferences for those minute quirks. These predilections can quickly split a single population of fish into two, each with its own electric penchants and the signals to match. This process is called sexual selection, and it runs at high gear within the mormyrins. These fish have diversified their electric signals 10 times faster than other elephantfishes and given rise to new species at three

to five times the rate seen elsewhere. Today, there are at least 175 species of mormyrins, compared to just 30 or so species of other elephantfishes. From precision in their senses came variety in their forms.

Second, mormyrins have evolved more complex brains, perhaps in part to process the information that their souped-up knollenorgans detect. One species, the Ubangi elephantfish (or Peters's elephantnose), has a brain that makes up 3 percent of its body weight and consumes 60 percent of its oxygen.[*16] "With such a brain, you'd imagine that they're building castles or composing symphonies," Nate Sawtell, who studies these fish, tells me. "We haven't seen that, but when you look at them, you can tell they're not goldfish. They're canny and aware."

He illustrates this by taking me to see a group of Ubangi elephantfish that live in his New York lab. Their bodies are long, brown, and flattened; their tails are forked; and their faces end in a mobile appendage called the schnauzenorgan. This is why they're called elephantfish, but the appendages are chins, not noses—think pharaoh, not Pinocchio. While the other electric fish that I've met were placid and ethereal, these seem frenetic and high-strung.[*17] They *explore* the electrode that Sawtell dips in the water. They probe the sandy floor of their tanks with their schnauzenorgans, which are especially rich in electroreceptors. Sometimes two individuals line up so that the electric organs in their tails are right next to the glut of electroreceptors in their partner's head. Then they buzz frantically, like two people shouting a duet into each other's ears. They chase each other. They seem to play.[*18]

As I watch these fish, I wonder what a social life governed by electric signals must be like. These animals can't hide from each other. In setting off their electric

discharges to sense their environment, they unavoidably announce their presence and identities to any other electric fish within range. A river full of electric fish must be like a cocktail party where no one *ever* shuts up, even when their mouths are full.

And here's the part that really baffles me: The fish use the same discharges for navigation and communication. The electric fields they generate to send signals to other fish are the very ones they use when electrolocating. This simple fact means that when the fish alter their fields to convey messages, they must also change their own ability to navigate or forage. For example, electric fish that lose fights will often briefly pause their pulses as a sign of submission—but this also temporarily shuts down their awareness of their surroundings. For them, communication alters perception. When you listen to a bird's song, you might not be able to hear everything the creature is saying, but you can be sure it's saying *something*. But if you hear one electric fish buzzing near another, is it trying to send a message or work out where the other animal is, or some combination of the two? Does the distinction between navigation and communication even matter to the fish?

"We don't know much about the richer aspects of their lives, the cognitive aspects, what you know about your pet cat or dog," Sawtell tells me. After decades of work, scientists know more about an electric fish's nervous system than that of most other animals. They can draw detailed maps of the neural circuits that drive the electric sense, but the sense still seems otherworldly. And yet, it is surprisingly common.

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IN 1678, ITALIAN physician Stefano Lorenzini noticed that the face of the electric torpedo ray was freckled with small pores—thousands of them, each opening into a jelly-filled tube. Other rays had similar pores and tubes, as did their close relatives, the sharks. These structures eventually became known as the ampullae of Lorenzini, but neither he nor any of his contemporaries knew what they were for. Clues slowly trickled in over several centuries. Better microscopes revealed that each tube ended in a bulbous chamber (or ampulla) that was connected to a single nerve—imagine a butternut squash with a string coming from its bottom. They must be sense organs. But what did they sense? In 1960, biologist R. W. Murray finally showed that the ampullae responded to electric fields. A few years later, Sven Dijkgraaf and his student Adrianus Kalmijn confirmed his idea. The duo showed that sharks will reflexively blink when exposed to electric fields, but not if the nerves in their ampullae of Lorenzini have been cut. These squash-shaped structures were electroreceptors.[*19]

The answer to this three-century mystery only raised more questions. By the 1960s, Hans Lissmann had already shown that weakly electric fish could navigate by sensing their own electric fields. But sharks and rays couldn't possibly be electrolocating because, aside from the torpedo ray, they didn't produce their own electricity. Why, then, did they have electroreceptors?

It turns out that *all* living things produce electric fields when submerged in water. Remember that animal cells are bags of salty liquid. The concentration of those salts differs from that of the surrounding water, setting up a voltage across the cells' membranes. When charged ions move across the membranes, they create a current. This is the same basic setup as a battery—charged particles create

currents when they move between two salt solutions separated by a barrier. Animal bodies, then, are living batteries, producing bioelectric fields through the mere act of existing. These fields are thousands of times fainter than those produced by even weakly electric fish, and they're damped further by insulating coverings like skin and shells. But at certain exposed body sites like mouths, gills, anuses, and (important for sharks) wounds, they're strong enough to be detected. Sharks and rays can home in on these fields to find their prey, even when their other senses fail them. [*20]

Kalmijn proved as much in 1971. He showed that the small-spotted catshark could always detect tasty flounders, even when the fish were buried in sand, and even if they were first put in an agar chamber that blocked smells and mechanical cues. The sharks only failed when the flounders were covered by an electrically insulating plastic sheet. When Kalmijn removed the flounders altogether, and instead duplicated the fish's weak electric fields using buried electrodes, the sharks "dug tenaciously at the source of the field, responding again and again when coming across the electrodes," he wrote. Wild sharks will also bite at buried electrodes. Some do so from birth.

The shark's electric sense is known as passive electroreception, and it's different from what we've seen so far. Sharks and rays aren't actively producing their own electric fields to locate objects around them, but passively detecting the electric fields of other animals—and mostly prey.[*21] They are exceptionally good at that, perhaps more so than any other group of animals.[*22] Stephen Kajiura showed that a small species of hammerhead can detect an electric field of just one nanovolt—a *billionth* of a volt—across a centimeter of water.[*23] A shark's electric sense

only works at short range, however. It can't sense a buried fish (or electrode) from across an ocean, or even from across a pool. It has to be within an arm's length of its target. Over mile distances, a shark sniffs out its food. As it draws near, vision takes over. Nearer still, the lateral line chips in. Its electric sense only enters the fray at the close of the hunt, to pinpoint the exact position of its prey and guide its strike. That's why the ampullae of Lorenzini are usually concentrated around the mouth.[*24]

Passive electroreception is especially useful for finding hidden prey. Animals, after all, can't turn off their natural electric fields.[*25] But if a shark can't rely on other senses—say, when its prey are buried, as in Kalmijn's experiment—it has to swim around until its ampullae of Lorenzini are close enough to a target. Some species have expedited that search by enlarging their heads. Instead of conical snouts, hammerhead sharks have broad, flattened heads that look like car spoilers. The undersides of their "hammers" are loaded with ampullae, and the sharks use these as one might use metal detectors, sweeping them over the seafloor in search of buried (edible) riches. They're not more electrically sensitive than other sharks, but their heads allow them to scan a wider area in a given time.

Sawfish can do this, too. These animals are actually rays, but their bodies look more like sharks and their heads look more like medieval weaponry. Their snouts end in long, flattened blades with fiendish teeth protruding from both sides. This "saw" can make up a third of its owner's body length, and it is packed with ampullae, top and bottom. It greatly extends the sawfish's electrical awareness into the space ahead of it—a useful trait in turbid water. "We find them in rivers where we can't even see our boat's propeller," says Barbara Wueringer, who studies these

animals. She showed that the saw doubles as both sensor and weapon. When fish swim above the saw, the sawfish slashes at them, using its sideways teeth to impale, stun, and bisect. When the wounded fish fall to the bottom, the sawfish uses the underside of its saw to find and pin them. “Whenever I see them, I think: How is this a thing?” Wueringer tells me.[*26]

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THE ABILITY TO detect electric fields is not unique to sharks and rays. Among vertebrates, around one in six species shares this sense. The list includes lampreys, sinuous fish with toothy suckers instead of jaws; coelacanths, ancient fish that were thought to have gone extinct until they were found alive in the 1930s; other groups of ancient fish including paddlefishes, which use their long, electroreceptor-rich snouts to find prey much the way sawfishes use their saws; the knifefishes and elephantfishes, which can sense the electric fields of other creatures as well as their own; the thousands of species of catfish, many of which hunt electric fish; and some amphibians like salamanders and the worm-like caecilians.

There are even mammals with electric senses.[*27] At least one species of dolphin—the Guiana dolphin of South America—has this skill, although it’s hard to imagine what benefit it could get from just 8 to 14 electroreceptors, when it already has echolocation at its disposal. Simi larly, it’s unclear how the echidnas—egg-laying mammals from Australia that resemble bulky hedgehogs—use the electroreceptors on the tips of their snouts. Perhaps they sense small insects moving about within moist soil. Their close relative, the platypus, also has over 50,000

electroreceptors on its famous duck-like bill. As it dives for food, it frenetically sweeps the bill from side to side like a hammerhead shark. Underwater, its eyes, ears, and nostrils are closed; it relies on touch and its electric sense alone.

This extensive cabal of electroreceptive critters tells us three important things. First, this is an ancient sense. Electroreceptors first evolved from the lateral line a long time ago, and the common ancestor of all living vertebrates might well have sensed electric fields. You do not have an electric sense, but if you traced your family tree back 600 million years, your ancestors almost certainly did. Second, vertebrates have *lost* the electric sense on at least four occasions during their evolutionary history, which is why hagfish, frogs, reptiles, birds, almost all mammals, and the majority of fish don't have it.[*28] Third, having lost the sense, several vertebrate groups, including the platypuses and echidnas, Guiana dolphins, and electric fish, then regained the ability that their ancestors had but their relatives don't.[*29] The knifefishes and elephantfishes are special cases. On opposite sides of the world, they independently and successively evolved three kinds of electroreceptors: first, for passively detecting the electric fields of other fish; then, for actively sensing their own self-made fields; and finally, for detecting the fields of other electric fish.[*30] The history of these two groups is a spectacular example of convergent evolution, where two different groups of organisms accidentally show up at life's party in the same outfits.

The convoluted history of the electric sense also hints at something special about electroreceptors. The language of the brain is electricity, and as we've seen, animals have had to evolve weird ways of converting light, sound, odorants, and other stimuli into electrical signals. But

electroreceptors are just translating electricity into electricity. They're the only sense organs that detect the very entity that powers our thoughts. Perhaps it's not that difficult to evolve an electroreceptor, and that's why they repeatedly blink in and out of the vertebrate evolutionary tree.

Electroreceptors do seem to have one important limitation: They only work when immersed in a conductive medium. Water certainly counts, and it's no coincidence that almost every electroreceptive animal we've met so far is aquatic.[*31] Air, by contrast, is an insulator, with a resistivity 20 billion times higher than water. For good reason, scientists have long assumed that an electric sense simply couldn't work on land.

And then Daniel Robert did an incredible experiment with bees.

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EVERY DAY, AROUND 40,000 thunderstorms crackle around the world. Collectively, they turn Earth's atmosphere into a giant electric circuit. Whenever lightning strikes the ground, electric charge moves upward, so the upper atmosphere ends up with a positive charge and the planet's surface with a negative one. This is the atmospheric potential gradient—a strong electric field that stretches from sky to ground. Even on calm, sunny days, the air carries a voltage of around 100 volts for every meter off the ground. Whenever I write about this, someone inevitably tells me that I must have made a misprint, and I assure you that I have not: There really is a gradient of *at least* 100 volts per meter outside your door.

Life exists within that planetary electric field and is affected by it. Flowers, being full of water, are electrically grounded, and bear the same negative charge as the soil from which they sprout. Bees, meanwhile, build up positive charges as they fly, possibly because electrons are torn from their surface when they collide with dust and other small particles. When positively charged bees arrive at negatively charged flowers, sparks don't fly, but pollen does. Attracted by their opposing charges, pollen grains will leap from a flower onto a bee, even before the insect lands. This phenomenon was described decades ago. But when Daniel Robert read about it, he realized there must be more to the electric world of bees and flowers. (We met Robert in the chapter on hearing because of his work on the *Ormia* fly.)

Although flowers are negatively charged, they grow into the positively charged air. Their very presence greatly strengthens the electric fields around them, and this effect is especially pronounced at points and edges, like leaf tips, petal rims, stigmas, and anthers. Based on its shape and size, every flower is surrounded by its own distinctive electric field. As Robert pondered these fields, "suddenly the question came: Do bees know about this?" he recalls. "And the answer was yes."

In 2013, Robert and his colleagues tested bumblebees with artificial "e-flowers," whose electric fields they could control. They baited a charged e-flower with sweet nectar, and a charge-less one with bitter liquid. The fake blooms were otherwise identical, but the bees quickly learned to tell them apart using electric cues alone. They could even distinguish between e-flowers with differently shaped electric fields—one with voltage spread evenly over its petals, and another with a field shaped like a bullseye.[*32]

These patterns are artificial, of course, but real flowers have similar ones. Robert's team visualized these by spraying foxgloves, petunias, and gerberas with charged colored powder. The powder settled around the edges of petals, demarcating patterns that would be otherwise invisible. Alongside the bright colors that we can see (and the ultraviolet ones we cannot), flowers are also surrounded by invisible electric halos. And bumblebees can sense these. "We just jumped to the ceiling when we saw what the bees were telling us," Robert tells me.[*33]

Bumblebees don't have ampullae of Lorenzini. Instead, their electroreceptors are the tiny hairs that make them so endearingly fuzzy. These hairs are sensitive to air currents and trigger nervous signals when they are deflected. But the electric fields around flowers are also strong enough to move them. Bees, though very different from electric fish or sharks, also seem to detect electric fields with an extended sense of touch. And they are almost certainly not the only land-based animals to do so. As we saw in Chapter 6, many insects, spiders, and other arthropods are covered in touch-sensitive hairs. If these hairs can also be deflected by electric fields, and Robert suspects they can, then electric senses might be even more common on land than in the water.

The mere possibility of widespread aerial electroreception has staggering implications. Just think about pollination. Have flowers evolved shapes that produce especially attractive electric patterns? Honeybees tell each other about food sources through their famous waggle dances, and they can sense the electric fields produced by waggling hive-mates; do these fields add another layer of meaning to the dance? A visiting bee temporarily changes a flower's electric field; could this tell

other bees that a flower has been recently visited and might be out of nectar? Could flowers lie to bees by quickly resetting their fields to signify that they're open for business? Do flowers feel different in rain and fog, when the atmospheric potential gradient can be 10 times stronger than on clear days? "We don't feel it," Robert says, "but do they?"

What about other arthropods? Atmospheric electric fields are most strongly distorted by the extremities of plants, but many insects that live on plants have spikes, hairs, and strange protrusions. Could these be antennae for detecting the charges of incoming threats? Could they be similar to a luna moth's long tails—decoys that alter the way these insects appear to electrically sensitive predators? The answer to all these questions might well be no, but what if the answer to just a few of them is yes? We've already seen that the insect world must be radically richer than what we imagine, full of subtle air currents, vibrational signals, and other stimuli to which we are oblivious. Now we must add electric fields to the mix. It's telling that just five years after his bumblebee experiments, Robert found evidence of electroreception in another familiar group of arthropods. He found that spiders can sense Earth's electric field and ride it.

Many spiders travel over long distances by "ballooning." They stand on tiptoe, raise their abdomens to the sky, extrude strands of silk, and take off. Carried aloft, they can float for miles. It is commonly said that the silk catches the wind and pulls the spider along, but spiders can still balloon successfully on calm days.[*34] In 2018, Robert's colleague Erica Morley found a better explanation. Spider silk picks up a negative charge as it leaves a spider's body, and is repelled by the negatively charged plants on which

they sit. That force, though tiny, is enough to launch the spider into the air. And since the electric fields around plants are strongest at points and edges, spiders can ensure a vigorous takeoff by ballooning from twigs and blades of grass. In her lab, Morley gave them cardboard strips instead of grass. She then exposed them to artificial electric fields that mimicked those outside. When the fields ruffled the sensory hairs on the spiders' legs, the animals adopted the characteristic tiptoe posture and began releasing silk. Even without the slightest breeze around them, some managed to take off. "I could see them levitating," she tells me, "and if I switched the electric field on and off, they would move up and down."

Through these experiments, Morley proved a very old idea. Back in 1828, another scientist had suggested that spiders ride electrostatic forces, but the idea was dismissed by a rival who favored the wind idea (and wrote a very long-winded letter about it). The rival won, and the electrostatic idea fell out of favor for two centuries. "Wind is tangible," Robert tells me. "People could feel it. Electrics were more elusive."

They still are. Electric senses are still hard to study, though Robert is trying. His work on bumblebees and spiders has changed the way he thinks about the insect and arachnid world. In his own garden, he noticed that young ladybugs will drop to the ground when he brings a charged acrylic rod near them. These larvae have tiny tufts of hair on their backs, and Robert wonders if they can sense the electric charge of an approaching predator. This is what he does now—reimagining his own backyard in a way that reminds me of Rex Cocroft prospecting for new vibrational songs. But while Cocroft can easily convert vibrations into audible noises, Robert can't do the same for electric fields.

There are no cameras that can photograph those fields. There's no rich lexicon of words for describing them. *Current, voltage,* and *potential* carry none of the evocative appeal that *sweet, red,* and *soft* possess. "It is very hard to put myself in the skin [of an insect] and imagine what is happening," he tells me. "This is a young science. But I don't think we can ignore it."

The electric sense might stretch his imagination, but at least he knows that some insects have it. He can guess what the others might do with it, and design experiments to test those reactions. And he knows what the likely receptors are, and how they might work. These are all important boons, and they shouldn't be taken for granted. There is another sense whose scholars are not so lucky.

SKIP NOTES

*1 The Greeks referred to the torpedo ray as *nárkē,* from which the modern word *narcotic* derives. The history of electric fish and their contributions to science is fascinating, and far richer than the meager paragraph I've allotted to it. For a fuller account, try *The Shocking History of Electric Fishes* by Stanley Finger and Marco Piccolino.

*2 This is not apocryphal hyperbole. In 1800, Chayma fishers in South America helped the naturalist Alexander von Humboldt collect electric eels by driving 30 horses and mules into a pool filled with the fish. The eels leapt out of the water, pressed themselves against the horses, and electrocuted them. After the chaos died down, the exhausted fish could be easily scooped up. Two horses died in the process.

*3 Though electric eels have been known for centuries, much of what we know about them was only discovered recently. Ken Catania, that eclectic aficionado of star-nosed moles, earthworms, and crocodiles, showed that they can remote-control their prey. And a team led by Carlos David de Santana showed that the iconic animal is actually three separate species, one of which packs a much stronger voltage than anyone had previously measured.

*4 MacIver once created a musical installation consisting of 12 electric fish of different species, each housed in a separate tank. The fish all produced electric fields at different frequencies, and electrodes in their tanks converted those fields into musical tones. Visitors could stand at a mixing board and turn the volume on each tank up or down, conducting the electric orchestra. “I was getting a little tired of people not appreciating electric fish, and I wanted to highlight that these are amazing animals that can give you a sense of wonder,” MacIver says.

*5 Confusingly, the species that Lissmann studied is called the African knifefish, but is more closely related to the elephantfishes than the actual knifefishes (which are all South American). The black ghost knifefish, you’ll be glad to know, is actually a knifefish, certainly blackish, and rather ghostly.

*6 The recipe is called Maler’s muck, after pioneering researcher Leonard Maler.

*7 Some species of electric fish seem to have evolved electric senses that work best within narrow ranges of salinity. “ A most interesting consequence may be that these fish might confront invisible barriers when they attempt to disperse into river systems that differ in water conductivity,” wrote Carl Hopkins in 2009.

*8 Of course, electric fish have other senses at their disposal, including those, like vision, that work over longer ranges. Elephantfish eyes seem to be tuned to large, fast-moving objects at a distance, which might theoretically help them detect predators before they come within range of the electric sense. Then again, many of these animals live in murky water, where long-range vision is impossible. And in the wild, many knifefish live perfectly well with parasitic worms in their eyes—a grisly sign that they can survive without vision.

*9 Angel Caputi has argued that for electric fish, the electric sense likely combines with the lateral line and proprioception—an animal’s awareness of its own body—to form a single integrated sense of touch.

*10 It is frankly incredible that the same basic sensor—the hair cell—has been adapted for sensing sound, water flow, and electrical fields.

*11 This isn’t as much of a stretch as it might seem. The neuromasts of the lateral line are already electrically sensitive, but a hundred to a thousand times less so than the electroreceptors of electric fish.

*12 “One of the worst things that happened to our field was when RadioShack went out of business,” Fortune tells me.

*13 They aren’t much troubled by ambient noise, either, with one exception—distant lightning storms create electromagnetic waves that travel for thousands of miles. These create clicks that electrodes can certainly detect, and that electric fish possibly could.

*14 In *Sensory Exotica,* Howard Hughes wrote that if you set a clock by a black ghost knifefish’s electric field, the device would only lose an hour every year.

*15 If two *Eigenmannia* meet and their electric discharges are close in frequency, they’ll shift their signals away from each other. This is called the jamming avoidance response, and it’s one of the most thoroughly studied behaviors in any vertebrate.

*16 For comparison, human brains make up around 2 to 2.5 percent of our body weight and soak up 20 percent of our oxygen. One can’t directly compare these proportions between animals of different sizes and that are variously warm-blooded and cold-blooded. Also, intelligence can’t be measured by brain size alone. Still, the point remains: The elephantfish is unusually big-brained.

*17 Carlson has shown that one mormyrid—the Cornish jack—hunts in packs. “In the lab, if we were to put two of them in the same tank, at least one of them would die, and quite possibly both,” he tells me, because they would fight to the death. But in Lake Malawi (one of the few electric fish habitats with water clear enough to see through), the jacks would come out at night, gang up with the same group of peers, and chase after smaller fish. They often produce bursts of electric pulses when reuniting, which might act as a mutual acknowledgment—a signal that keeps the pack together.

*18 Bruce Carlson tells me he has seen large elephantfish playing with the tubes in their tanks. “They’ll swim into one, lift it up to the surface, and try to balance it there as long as they can until it falls,” he says. “Then they go and do it again.”

*19 The jelly inside the ampullae of Lorenzini is extremely conductive. It acts like a cable, transferring the electric field of the surrounding water into the bottom of the ampullae, where it is detected by a layer of sensory cells. The cells compare those properties to those of the animal’s own body, and relay that information to the brain. By combining the signals from these cells across

thousands of ampullae, the shark can build up a sense of the electric field around it.

*20 It's sometimes said that sharks and rays detect electric fields produced by moving muscles. But while such movements do produce electric fields, they are typically below the detection range of electroreceptors.

*21 Not always, though. Some stingrays use electric fields to find buried mates. And some embryonic sharks freeze when they detect the electric fields of passing predators—a feat that reminds me of Karen Warkentin's tree frogs.

*22 Technically, even humans can sense electricity if it is strong enough. We just don't have any sense organs dedicated to the task. Instead, strong currents indiscriminately stimulate our nerves, producing tingling, pain, and twitching. Even then, we can only feel electric fields of 0.1 to 1 volt per centimeter. Sharks are around a billion times more sensitive, and the experience for them doesn't suck.

*23 It's often said that to set up a field that faint with a normal AA battery, you'd have to connect its ends to electrodes dipped into opposite sides of the Atlantic. This metaphor, though evocative, conjures up an entirely inappropriate sense of scale. In reality, sharks are after electric fields considerably fainter than those of a battery, and said fields weaken with distance, which is why a shark's electric sense only works at short range.

*24 It's also why electric fields trigger the blinking reflex that Dijkgraaf and Kalmijn saw: Sharks protect their eyes in anticipation of a lunge.

*25 They can reduce their fields, though. When cuttlefish see the looming shapes of sharks, they'll stop moving, hold their breath, and cover their gill cavities. Christine Bedore showed that these acts reduce the voltage of their electric fields by almost 90 percent, and halve their risk of being bitten. Cuttlefish don't behave in this way when menaced by crabs, which can't sense electric fields.

*26 Wueringer founded an organization called Sharks and Rays Australia to save sawfish and their relatives. The same saws that make them masters of electroreception also make dramatic trophies, and get easily caught in nets. The five species are all endangered, three of them critically so.

*27 There's a paper claiming that star-nosed moles have an electric sense, but Ken Catania, who looked for such a sense when he first studied the animal,

tells me he found no evidence for it.

*28 No one really knows why so many creatures have lost electroreception, especially since the sense is so useful for finding hidden prey underwater. Bruce Carlson tells me he hasn't even heard any good hypotheses. "It's kind of a mystery," he says.

*29 Each of these groups ended up with its own distinctive electroreceptors (and only those in sharks and rays bear Lorenzini's name). But despite their variety, these organs share the same basic structure. There's almost always a pore that leads from the surface into a jelly-filled chamber, with sensory cells at its base. In many cases, these structures are derived from the lateral line. But the Guiana dolphin evolved its electroreceptors by modifying whisker pits, which are now devoid of hairs and full of conductive jelly.

*30 These events happened at roughly the same times, too. Both groups of fish evolved passive electroreceptors between 110 and 120 million years ago, before evolving active electroreceptors after another 15 to 20 million years.

*31 Echidnas are the exception, but they still probably have to dip their electroreceptors into wet soil.

*32 The bees also learned to more quickly distinguish between flowers of similar colors if electric cues were present as well.

*33 Although other scientists had already shown that cockroaches, flies, and other insects can react to electric fields, they normally ran experiments with fields that are much stronger than natural ones. That's not very instructive: Even humans can detect extremely strong electric fields, because our hairs stand on end. Robert's study was important because it showed that bumblebees detect electric fields at biologically relevant strengths, that they can use that information to guide actual meaningful behaviors like choosing where to drink, and that they sense subtle cues like the bullseye pattern.

*34 The wind explanation also makes no sense because most spiders don't shoot silk from their abdomens. The silk must be pulled out. Spiders normally do this with their legs, or by first attaching the silk to a surface. But ballooning spiders are doing neither, and it's unlikely that gentle breezes are strong enough to yank out the threads. Electrostatic forces are.

11.

They Know the Way

Magnetic Fields

AFTER SUNSET, WHEN THE HIKERS and tourists have all gone, Eric Warrant and I drive into Kosciuszko National Park, a protected area within Australia's Snowy Mountains. The kangaroos and wombats are out, but we ignore them on our search for much smaller fauna. At 1,600 meters above sea level, we pull over into a quiet spot. I warm my hands on a cup of tea, while Warrant hangs a vertical white sheet between two trees. From below, he illuminates the sheet with a huge light that he calls the Eye of Sauron. From the sheet's corners, he hangs two smaller lamps, whose ultraviolet hues are calibrated to attract insects. We know there are plenty about, because we can hear the echolocation calls of bats hunting above us. Soon, we also hear the loud thud of a large insect hitting the sheet. As it drops to the grass, so does Warrant, who giddily scoops it up. "Yeah, that's definitely a bogong," he tells me, holding up a plastic jar. Inside is an inch-long moth with drab, bark-colored wings. Outwardly, it's not obvious why this creature should so warrant Warrant's delight.

"They really don't look like much," I say.

"No," Warrant says with a chuckle, "and that belies their hidden talents."

Hinting at said talents, the moth in the jar flutters furiously. Many captured insects will sit calmly, but this one seems possessed by a manic energy, some intense

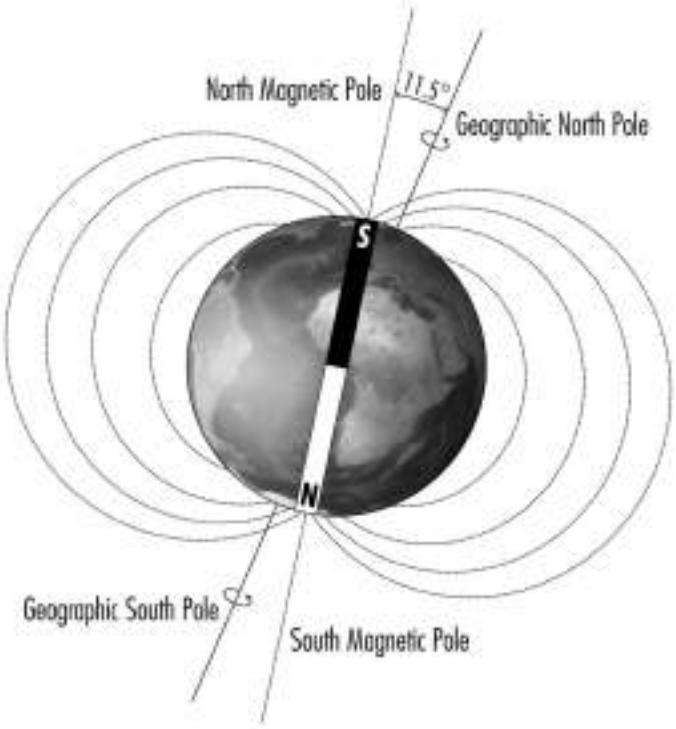
compulsion to be elsewhere. “It’s flighty as hell,” Warrant says. “It’s got places to go.”

Every spring, billions of bogongs emerge from their pupal stage in the dry plains of southeastern Australia. Anticipating the arrival of the baking summer, they flee toward cooler climes. And somehow, despite never having flown before, let alone migrated, they know which way to go. They fly over 600 miles and arrive at a few select alpine caves. Within these caves, every square meter of wall might be tiled by 17,000 bogongs, their wings overlapping like the scales of a fish. Safe and cool, they ride out the summer in a state of dormancy before making the return trip in autumn. On some nights when Warrant goes out to collect them with the Eye of Sauron he is “literally inundated by thousands of them,” he says.

The only other insect known to make such long migrations to such specific destinations is the monarch butterfly of North America. But while monarchs navigate during the day by using the sun as a compass, the bogongs only fly at night. How do they know the right direction? Warrant, who grew up among the Snowy Mountains and has loved the local insects since he was a child, has always wanted to find out. At first, he thought they might be using their sensitive eyes to observe the stars. And while he was right about that, on his first night of observing captive bogongs he noticed that they could still fly in the right direction without being able to see the sky. Warrant realized that they must be able to sense Earth’s magnetic field.

Earth’s core is a solid iron sphere surrounded by molten iron and nickel. The churning movements of that liquid metal turn the entire planet into a giant bar magnet. Its magnetic field can be depicted in the style of a school

textbook: Lines emerge near the south pole, curve around the globe, and reenter near the north pole. This geomagnetic field is always present. It doesn't change across the day or through the seasons. It's not affected by weather or obstacles. Consequently, it is a boon for travelers, who can always use it to establish their bearings. Humans have done so for more than a thousand years, using compasses. Other animals—sea turtles, spiny lobsters, songbirds, and many others—have done so for millions of years, without help.



Their ability, known as magnetoreception, allows them to navigate even when celestial bodies are obscured by clouds or darkness, when large landmarks are wreathed in fog or murk, and when the skies and oceans are devoid of telltale scents. You might think that Warrant, having learned that his precious bogongs are members of the

magnetoreception club, would be excited about studying such a fantastical sense. Instead, he jokes, “When I realized that the magnetic sense was important for the bogong, I thought: Oh no.”

Magnetoreception research has been polluted by fierce rivalries and confusing errors, and the sense itself is famously difficult both to study and to comprehend. There are open questions about all the senses, but at least with vision, smell, or even electroreception, researchers know roughly how they work and which sense organs are involved. Neither is true for magnetoreception. It remains the sense that we know least about, even though its existence was confirmed decades ago.

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THE GEOMAGNETIC FIELD envelops the entire planet and guides animals over migrations that can span continents. But even the most epic journeys must begin with a few tentative steps, and it was through such steps that magnetoreception was first discovered.

When the time comes for birds to migrate, they become visibly restless. Even in captivity, they’ll hop, flit, and flutter. These frantic movements are known as *Zugunruhe*—a German word that means “migration anxiety.” The birds know it’s time. They long to get going. And as German ornithologist Friedrich Merkel realized in the 1950s, they know the way. Merkel and his students Hans Fromme and Wolfgang Wiltschko captured European robins in the autumn and noticed the birds’ migration anxiety wasn’t random.[*1] At night, they tended to hop toward the southwest—exactly the direction that, were it not for their cages, would take them to sunny Spain. They did so

outdoors when they could see the night sky. But they also kept their bearings in shuttered rooms, where celestial landmarks were hidden from view. This was the same pattern that Warrant would observe in the bogongs half a century later. And in the 1950s, it led Merkel's team to the same epiphany: The birds had to be using another cue, and the geomagnetic field was a possibility.

The idea of magnetoreception wasn't new. In 1859, the zoologist Alexander von Middendorff had suggested that birds, "those sailors of the air," might "possess an inner magnetic feeling." But, for a century, neither he nor anyone else had any data to back up this seemingly outlandish idea. Absent such proof, even Donald Griffin, who was no stranger to unusual animal senses, was skeptical. In 1944, the same year that Griffin coined the word *echolocation,* he wrote that a magnetic sense was "extremely unlikely." The concept was worth taking seriously only because nothing else seemed to adequately explain how migrating birds know where to fly. Magnetoreception was an idea that survived in the absence of better ones. It was a hypothesis in want of evidence.

Merkel and Wiltschko provided that evidence.[*2] First, they recorded the direction of the robins' hops by placing them in an octagonal chamber with a perch on each wall. Every time a bird jumped onto a perch, it triggered a weight-sensitive switch that punched a record of its movements onto paper tape. Later, the team used a simpler but more effective method. They put the birds in a funnel with an ink pad at its base and blotting paper on its sides. Then they counted the inky footprints that the birds left as they tried to jump out.[*3] These were tedious experiments that could only be done in the narrow annual window when birds experience *Zugunruhe*. But they provided clear

quantitative evidence that the robins head southwest in the fall. To confirm that the birds rely on a magnetic sense, Wiltschko flipped the magnetic field around them. In the 1960s, he began putting their cages in the middle of Helmholtz coils—pairs of looped wires that can generate artificial magnetic fields between them. When Wiltschko used the coils to rotate the fields around the robins, the birds shifted the direction of their hops accordingly. They had an internal biological compass.

These experiments were still met with skepticism, and for good reason. Earth's magnetic field is extremely weak. It is so faint that the random jiggling movements of an animal's molecules can carry *200 billion times* more energy. No creature should be able to sense such an absurdly weak stimulus. And yet the robins clearly could.[*4] They're not unique, either. Many scientists, including Wiltschko and his wife, Roswitha, have repeated the original robin experiments with several other bird species, including garden warblers and indigo buntings, whitethroats and blackcaps, goldcrests and silvereyes. The "inner magnetic feeling" that Middendorff imagined not only exists but is *common*.

Since Merkel's robins took their pioneering footsteps, scientists have found evidence of magnetoreception throughout the animal kingdom. Yet unlike almost every other sense we've met so far, this one is not used for communication. Animals don't produce magnetic fields, and the only such field that they have evolved to detect is Earth's. They do so mostly to navigate over distances large and small. After a busy night of insect-catching, big brown bats use a compass sense to return to their home roosts. After an early life in the open ocean, baby cardinal fish use a compass sense to swim back to the coral reefs where they

were born. Mole-rats use their compass to find their way through their dark underground tunnels. And bogong moths, as Warrant found, use theirs to orient on their trans-Australian flights.

Most of these animals have been tested with some variation of the Wiltschkos' classic experiment: Put the animal in an arena, change the magnetic field around it, and see if it moves in a different direction. That's possible with an animal the size of a robin or a moth. "You can't really do that with a whale," says biophysicist Jesse Granger. "But whales have some of the most insane migrations of any animals on the planet. Some of them almost go from the equator to the poles, and with astounding precision, traveling to the exact same area year after year." It's easy to think that they, too, have a magnetic sense.

To see if they do, Granger looked to the sun itself. The sun periodically throws cosmic tantrums and produces solar storms—streams of radiation and charged particles that affect Earth's magnetic field. Such storms could conceivably mess up the compasses of magnetically sensitive whales, and if these animals are close to a shoreline, even a small navigational error might send them aground. To test this idea, Granger collated 33 years' worth of records of healthy, uninjured gray whales inexplicably stranding themselves. She compared the timing of these incidents to data on solar activity, wrangled by her astronomer colleague Lucianne Walkowicz. A striking pattern emerged: On days with the most intense solar storms, gray whales were four times more likely to beach themselves.[*5]

This correlation doesn't prove that whales have a compass, but it strongly hints that they do. More than that,

it speaks to the awesome nature of magnetoreception. Here is a sense in which the forces produced by a planetary layer of molten metal collide with those unleashed by a tempestuous star, together swaying the mind of a wandering animal and determining whether it finds its way successfully or loses it for good.

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FEW MIGRATIONS ARE as treacherous or as lengthy as those undertaken by sea turtles. Hatching from an egg that was buried in a sandy beach, a baby turtle must run a gauntlet of crab claws and bird beaks on its ungainly crawl toward the ocean. Once in the water, it must flee from the coastal shallows, where it can be easily grabbed from above by seabirds and from below by predatory fish. To find some semblance of safety, it must reach the open ocean as quickly as possible. For a turtle that hatches in Florida, that means swimming due east until it reaches the North Atlantic gyre—a clockwise current that spans the ocean between North America and Europe. The hatchling somehow stays within this loop for 5 to 10 years, hiding out among clumps of floating seaweed and slowly gaining in size. By the time it completes its full (and very slow) lap of the Atlantic and returns to North American waters, it is invulnerable to all but the largest sharks.[*6]

By the 1990s, no one had worked out how inexperienced turtles could pull off such grand migrations—a state of ignorance that the late Archie Carr lamented as “an insult to science.” At first, Ken Lohmann couldn’t understand the fuss. Armed with a newly acquired PhD and the hubris of youth, he thought the answer was obvious: The turtles must use a magnetic compass. It would be a simple matter to

build his own magnetic coils and put hatchlings through some version of the then-classic robin experiments. He had signed up for a two-year project, and “my main concern was what I would do for the second year,” he tells me. “That was over 30 years ago. The only part I got right was that they have a magnetic sense.” He didn’t realize that they have two.

As Lohmann suspected, and as he showed in 1991, turtles have a compass. But their other magnetic sense proved to be even more impressive. It hinges on two properties of the geomagnetic field. The first is *inclination*—the angle at which the geomagnetic field lines meet Earth’s surface. At the equator, those lines run parallel to the ground; at the magnetic poles, they are perpendicular. The second property is *intensity*—differences in the field’s strength. Both inclination and intensity vary around the globe, and most spots in the ocean have a unique combination of the two. Together, they act like coordinates, much like latitude and longitude. They allow the geomagnetic field to act as an oceanic map. And turtles, as Lohmann found, can read that map.

In the mid-1990s, he and his wife, Catherine, took captive loggerhead hatchlings on a magnetic tour of the Atlantic. They exposed the babies to the same inclinations and intensities that they would experience at various places along their long circuit. Amazingly, the turtles knew what to do at each point, and would swim in directions that would keep them within the gyre. This would only be possible if the turtles had both a compass to tell them which way to go and a map to tell them where they were. Only with both senses can they change direction at the appropriate places.[*7]

The turtles' abilities are especially impressive because they are innate. The Lohmanns collected individuals who had only just hatched, kept them in captivity for a single night, and tested them just once. These hatchlings couldn't have learned how to interpret magnetic signals from other turtles. They hadn't even been in the ocean before. Their magnetic maps must be genetically encoded. Lohmann thinks it's unlikely that they're born with a full mental atlas of the entire Atlantic, against which they cross-reference the magnetic readings they feel. Instead, they probably rely on a few instincts that kick in at specific combinations of inclination and intensity that act as magnetic signposts. *When the magnetic field feels like A, head east. When it feels like B, go south.* "The turtle doesn't need to have a conception of where it actually is. It can swim along a pretty elaborate migratory route without needing a lot of information," Lohmann says. "But of course, there's no way of knowing what goes on inside a turtle's head."

Loggerheads that survive their North Atlantic migration end up back in Florida, where they settle down. As they age, they learn, and their magnetic maps get richer. If the Lohmanns captured these older turtles and exposed them to magnetic fields from different parts of the Florida coastline, the animals always swam in directions that would lead them home. They weren't just relying on the sparse signposts that they used as hatchlings. They seemed to know the magnetic topography of their home waters in richer detail.

Magnetic maps have an important limitation: From a given position, a turtle can sense the properties of the magnetic field immediately around it, but it can't tell what the field is like *over there*. To do that, it has to move. And it likely has to move over long distances, because magnetic

information isn’t especially accurate over short ones. You could use a magnetic sense to travel from Europe to Africa but not to find your bathroom from your bedroom. For this reason, most of the species that convincingly have a map sense use it to travel over long distances.[*8]

Some songbirds recognize magnetic signposts on their migration routes, just as turtle hatchlings do. Every winter, thrush nightingales must cross the immense Sahara Desert on their way from Europe to southern Africa. Once they sense the magnetic field of northern Egypt, they react by packing on more fat, in anticipation of the arduous desert crossing ahead. Other migrating songbirds can use these magnetic maps to adjust their bearing if they’re blown off course by strong winds—or flown off course by curious scientists. Eurasian reed warblers, for example, normally migrate northeast in the spring, but after Nikita Chernetsov flew some of these birds hundreds of miles to the east, they headed northwest instead.

Many animals, including salmon, turtles, and Manx shearwaters (a kind of seabird), can also imprint on the magnetic signature of their birthplaces, etching it deep within their memory so they can find the same sites as adults. Turtles use these imprints to lay eggs on the same beaches from which they hatched. Their accuracy is uncanny. Green turtles that nest on Ascension Island can find that same tiny nub of land in the middle of the Atlantic after a 1,200-mile journey to and from Brazil. This “natal homing” instinct is so strong that turtles will sometimes swim for hundreds of miles to their beach of birth, even though there’s a perfectly good alternative right next to them.[*9] Perhaps that’s because good nest sites are hard to find. They must be accessible from the water. The sand grains must be large enough to let oxygen through. The

temperature must be exactly right, since turtles develop as males or females depending on how hot or cold their eggs are. “A turtle might say: Well, the one place in the world I know works is the beach where I developed myself,” Lohmann says. And its magnetic map allows it to relocate that sure-bet nursery after years away at sea.

Lohmann is still studying turtles decades after his supposed two-year project.[*10] He has learned so much about their navigational skills, but there is so much left to learn. How quickly can they learn a set of magnetic coordinates? How do their brains represent inclination and intensity? And how do they (or any other animals) even sense magnetic fields at all? I asked Lohmann if he has any thoughts on that last vexing question. He laughs heartily. “Many thoughts and little evidence,” he tells me. “I’m optimistic that it’ll eventually get solved, but whether it’ll be in my lifetime or not is an open question.”

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IT’S NOT USUALLY difficult to find sense organs. Their job is to gather stimuli from an animal’s surroundings, and, since most stimuli are distorted by the tissues of an animal’s body, sense organs are almost always exposed directly to the environment or connected to it by an opening like a pupil or nostril. Such openings can be big clues. Scientists recognized that a rattlesnake’s pits, a shark’s ampullae of Lorenzini, and a fish’s lateral line were sense organs long before working out what they sensed. But researchers who study magnetoreception have no such hints. Magnetic fields can pass unimpeded through biological matter, so the cells that detect them—magnetoreceptors—could be anywhere. They don’t need openings like pupils and pits, or

focusing structures like lenses and ear flaps. They could be in heads, in toes, or in anything from head to toe. They could be buried deep within flesh. They could even be scattered throughout different body parts and not concentrated into sense organs at all. They could be indistinguishable from the tissues around them. Trying to find them, in the words of Sonke Johnsen, might be like searching for a "needle in a needle stack."

At the time of writing, magnetoreception remains the only sense without a known sensor. Magnetoreceptors are "the holy grail of sensory biology," Eric Warrant tells me. "There may even be a Nobel Prize in finding them." Researchers have amassed many important clues about their identity and whereabouts but also several false leads. And without knowing for sure what these receptors are, or even where they are, it is fiendishly difficult to know how they might work. There are, however, three plausible ideas.

The first involves a magnetic iron mineral known as magnetite. In the 1970s, scientists discovered that some bacteria turn themselves into living compass needles by growing chains of magnetite crystals inside their cells. When these microbes are shaken, they tend to swim either north or south. Animals could theoretically build their own magnetite compasses, too. Imagine a magnetite needle that's tethered to a sensory cell. As the animal turns, the needle tugs upon its tether. The cell registers that tension and triggers a nervous signal. In this way, cells could turn an abstract magnetic stimulus into something more tangible—a physical yank. "I think that's an utterly plausible idea," Warrant tells me, "but where those cells are is anybody's guess." Despite several frustrating false leads, nobody's ever found them.[*11]

The second hypothesis for how magnetoreceptors could work involves a phenomenon called electromagnetic induction, which mostly applies to sharks and rays. As a shark swims, it induces weak electric currents in the surrounding water, and the strength of those currents changes depending on the shark's angle relative to the geomagnetic field. By sensing these tiny variations with the electroreceptors we met in the last chapter, the shark could potentially determine its heading. Again, no one knows if this actually happens, but it's plausible. A shark's electric sense could double as a magnetic sense.

The induction explanation is often ignored because it's hard to imagine how it would work in animals like birds, which aren't immersed in a conductive fluid like water. But there is a way in which induction might apply to them. The French zoologist Camille Viguier predicted it in 1882, well before magnetoreception had even been confirmed. He noted that a bird's inner ear contains three canals full of conductive fluid. As a bird flies, the geomagnetic field could theoretically induce a detectable voltage in that fluid. Almost 130 years later, David Keays confirmed that he was right. Moreover, he found that these birds have the same protein in their inner ears that sharks use to sense electric fields. "I think induction is a realistic mechanism by which birds can detect magnetic fields, and we're testing it further at the moment," Keays tells me.[*12]

The third explanation for magnetoreception is the most complicated, but also the one that has gained the most momentum. It involves two molecules known as a *radical pair,* whose chemical reaction can be influenced by magnetic fields. To understand this deeply, you must delve into the strange realm of quantum physics. But to understand it well enough, you need only to imagine that

the two molecules are dancing. Light triggers the dance, cuing the partners to take hold of each other. Once in this excited state, they can be affected by magnetic fields, which alter the tempo of their dance, and thus its final steps. The partners' final positions offer a record of the magnetic fields that shaped their previous movements. Through their dance, the radical pair transforms a magnetic stimulus that is hard to detect into a chemical stimulus that is simple to assess.[*13]

In the 1970s, chemists were mostly studying radical pair reactions in test tubes. But in 1978 the German chemist Klaus Schulten suggested that these obscure reactions might also exist in the cells of birds, and explain their compass-like responses to magnetic fields. He submitted a paper describing this idea to the prestigious journal *Science,* and received a memorable rejection: *A less bold scientist may have designated this idea to the wastepaper basket*. Undeterred, he published the paper anyway. Unfortunately, he placed it in an obscure German journal, and wrote it in a way that was incomprehensible to any biologist who wasn't already well versed in quantum physics—which is to say, almost all of them. In retrospect, however, Schulten was well ahead of his time, and his insight about radical pairs was just the first of several major epiphanies.[*14]

The next occurred when Schulten presented his ideas in a lecture, and an attending Nobel laureate asked: *If radical pair reactions are triggered by light, where is the light in the bird?* Schulten realized that if magnetoreceptors depend on radical pairs, then they can't be found anywhere in an animal's body. Instead, they're probably in the organs best suited to collecting light. A songbird's compass, he suggested, lies in its eyes. This idea lay fallow until 1998,

when Schulten read about a new discovery. A group of molecules called *cryptochromes,* which were thought to only exist in animal brains, had also been found in their eyes. “I just fell off my chair,” Schulten told me, because he remembered that cryptochromes can form radical pairs with partner molecules called flavins. Here was the missing piece of his theory—a molecule that could take part in the dance he envisioned, and that happened to exist in just the right place.

In 2000, Schulten and his student Thorsten Ritz published a paper arguing that the songbird compass depends on cryptochromes in the eye. It was game-changing. Thanks to Ritz, it was finally comprehensible to biologists. It also gave those biologists something concrete to work with—an actual molecule that they could study. Experiment after experiment, researchers confirmed many of Schulten’s predictions. The Wiltschkos, for example, discovered that the songbird compass does indeed depend on light—and on blue or green light in particular.[*15]

Henrik Mouritsen, a Danish birdwatcher-turned-biologist who is now one of the leading figures in magnetoreception, also confirmed that light matters.[*16] He placed robins and garden warblers in a moonlit room, and filmed them with infrared cameras. When the birds started showing *Zugunruhe,* Mouritsen looked in their brains to see if any regions were especially active. He found one. Known as cluster N, it sits at the very front of the brain. It’s active when and only when migratory songbirds (and not non-migratory ones) are orienting with their compasses at night when they travel (and not during the day when they don’t). Cluster N seems to be the magnetic processing center of the bird’s brain. And, tellingly, it’s also part of the brain’s *visual centers*. Cluster N gets information from the retinas,

and only buzzes with activity if a bird's eyes are uncovered and if there's some light around.[*17] "I think this is one of the strongest pieces of evidence that exists" for the light-dependent radical pair idea, Mouritsen tells me.

These lines of evidence hint at a startling conclusion: Songbirds might be able to *see* Earth's magnetic field, perhaps as a subtle visual cue that overlays their normal field of view. "That's the most likely scenario, but we don't know because we can't ask the birds," Mouritsen says. Perhaps a flying robin always sees a bright spot in the direction of north. Perhaps it sees a gradient of shade painted over the landscape. "We have these drawings, and even though they're probably all wrong, they're good for imagining what the birds could be seeing."

While the radical pair idea looks most likely,[*18] all three hypotheses—magnetite, induction, and radical pairs—might be correct. "I think it's very clear that there is more than one mechanism," Keays tells me. And yet, many scientists have formed camps around the different hypotheses, as if one and only one can be correct. As if studying magnetoreception wasn't hard enough, toxic feuds have emerged. One conference infamously descended into farce, as grown adults stood up and screamed at each other. "Everybody wants to be the first to find the magnetoreceptor, which instantly makes people much more competitive and less likely to be nice to one another," Warrant tells me.

It also makes them sloppier.

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THROUGHOUT THIS BOOK, we've heard stories of scientists who were mocked or dismissed for ideas about animal

senses that ultimately proved to be right. But the opposite phenomenon is just as frequent, if not more so: Discoveries that were thought to be right are later refuted. Such cases are rife in magnetoreception.

A 1997 study claimed that honeybees can detect magnetic fields.[*19] Two decades later, another group showed that the original team had made such a big statistical error that they might as well have been studying random number generators instead of bees. In 1999, an American team claimed that monarch butterflies have a compass sense; they later retracted their paper when they realized that the insects had actually been orienting to light reflected off their clothes. In 2002, the Wiltschkos published a classic paper claiming that a robin only has a compass in its right eye and cannot orient with its left alone. A decade later, Henrik Mouritsen and his colleagues showed through careful experiments that both eyes contain compasses. In 2015, an American team allegedly found the magnetoreceptor in a nematode worm, while a Chinese group said they had found it in fruit flies. Neither study could be replicated by other researchers, and the fruit fly study was said to conflict with "the basic laws of physics."

To a degree, this is how science is meant to work. Scientists check each other's findings by repeating each other's experiments, building upon what can be replicated and debunking what cannot. But magnetoreception has been plagued by an unusual number of splashy studies that later prove incorrect. Some animals that supposedly have this sense likely don't.[*20] "We have spent a long time chasing other people's assertions, and been very patient," David Keays tells me wearily. "But so many are just fallacious." Science self-corrects, but the science of magnetoreception seems to require more correction than

most. Many claims about this sense are wrong. Throughout this book, we have seen that animal Umwelten are hard to appreciate because they are inherently subjective and because our senses hold us back from making the requisite imaginative leaps. But there's a simpler barrier that stops us from properly understanding other Umwelten: It is easy to study animal senses in misleading ways.

The study of animal behavior is also plagued by human behavior. People tend to see the patterns they want to see. Is that set of scratchy bird footprints really denser in the southwest corner, or are you just interpreting them that way because you expected the bird to head southwest?[*21] Scientists are no less prone to such biases than the average person, but they do have ways of preventing those biases from interfering with their work. For example, they can "blind" a study, withholding key pieces of information until the very last moment, even from themselves. This should be standard practice for all experiments. It isn't.

Making matters worse, the quest to find the elusive magnetoreceptor has become a race. The promise of glory and prizes for the winner has created incentives for fast research and big claims, rather than careful and methodical work. Researchers might run experiments with only a few animals, producing results that might just be flukes. They might tweak their experimental plans on the fly in a bid to find something exciting—a practice known as p-hacking. They might cherry-pick the best data while leaving out findings that don't fit their ideas.

Even if scientists do everything right, they might still flounder because magnetic fields are imperceptible. A researcher who studies vision or hearing would quickly realize if her equipment was accidentally producing bright flashes or loud screeches. But with magnetoreception, "you

simply don’t notice if you do something stupid,” Mouritsen tells me. You might be exposing animals to erratic or unnatural fields, and you’d have no idea unless you were constantly doing checks with the highest-quality equipment. You can dip into the Umwelt of an electric fish or a treehopper using equipment you can buy at a local store. But with magnetoreception, “you can’t work with cheap equipment,” Mouritsen says. “It’s very expensive to measure properly.”

Magnetic fields are also deeply counterintuitive. As the Insane Clown Posse famously noted, “Fuckin’ magnets, how do they work?” Or as Warrant said to me, “I have enough trouble even understanding the stimulus, never mind trying to understand what an animal might perceive from it.” Other unusual senses like echolocation and electroreception can at least be compared to more familiar ones like hearing or touch. But I have no idea how to begin thinking about the Umwelt of a loggerhead turtle.

I wonder if this is partly why the radical pair explanation has gained so much traction. Complicated though it is, it brings magnetoreception into the realm of vision, a sense that we can readily appreciate. Similarly, we talk of compasses because they offer a familiar gateway into the abstract world of magnetism. But the compass metaphor can be misleading. Compasses are precise and dependable. They have to point north, and they cannot waver. But Sonke Johnsen, Ken Lohmann, and Eric Warrant suspect that biological compasses are inherently noisy. That is, it might be impossible for them to instantly get a precise, accurate read on Earth’s magnetic field because that field is so weak. Animals might have to keep a running average of the signals from their magnetoreceptors over long periods of time. This limitation makes magnetoreception slow,

cumbersome, and deeply paradoxical. It detects one of the most pervasive and reliable stimuli on the planet—the geomagnetic field—but does so in an inherently unreliable way. This might explain why so many magnetoreception studies have been hard to replicate. “It could be genuinely difficult to get a consistent result even if you do the same excellent experiment more than once,” Warrant tells me. [*22]

Let’s say an animal needs five minutes to gather enough information from its erratically swinging compass to determine the right bearing. If experimenters expose it to a magnetic field and record its reactions after a minute, the results will be all over the place. I chose these windows of time arbitrarily, but the point is we don’t know the right ones. We are used to senses like vision or hearing that offer nigh-instantaneous information. Magnetoreception probably doesn’t work like that, but we don’t know the timescales over which it does work. Without knowing that, or without even realizing that you need to find out, it’s hard to design good experiments. As I wrote in the introduction, a scientist’s data are influenced by the questions she asks, which are steered by her imagination, which is delimited by her senses. The boundaries of our own Umwelt corral our ability to understand the Umwelten of others.

The noisy and erratic nature of magnetoreception might also explain why no animal relies on it alone. Instead, they seem to use it as a backup sense in case more reliable ones like vision fail. “If you’re a migrating animal, magnetoreception is probably the least important sense, unless you’re completely lost,” Keays says. In the absence of magnetic cues, bogong moths can still navigate by looking at the pattern of stars in the night sky. Turtle hatchlings ignore magnetic fields when they first enter the

water and use the direction of the waves to guide them out to sea.

Animals never use a single sense exclusively. “They use every damn piece of information they can get their hands on,” Warrant tells me. “They are multisensory in every possible way.”

SKIP NOTES

*1 The European robin is a completely different bird from the one Americans call a robin. Though both have red breasts, the latter is a medium-sized thrush that was named for the former, which is a small flycatcher.

*2 At roughly the same time, other researchers showed that simple animals like flatworms and mud snails can also respond to magnetic fields.

*3 This setup is called the Emlen funnel after its creator, Steve Emlen. Cheap and easy to use, it revolutionized the study of bird migration. It is still used today, although the inkpads and blotting paper have been replaced by Tipp-Ex paper or thermal paper that changes color when heated.

*4 In lab experiments, they can detect a 5-degree shift in the direction of the field they experience. In the wild, where they aren’t stressed by confinement, they’re probably more precise.

*5 Robins can also be sent off course by artificial magnetic fields that simulate the effects of a solar storm.

*6 It’s estimated that only 1 in every 10,000 hatchlings makes it this far.

*7 Over the last 83 million years, the geomagnetic field has reversed 183 times. Magnetic north becomes magnetic south and vice versa. These flips probably occur over thousands of years, so they’re unlikely to throw any individual turtle off course. But each turtle species must have experienced many magnetic reversals over their evolutionary history—and their magnetic maps must have adapted accordingly.

*8 Even apparently simple animals make use of magnetic maps. Caribbean spiny lobsters live in dens within coral reefs but will wander afar in search of food. As long as they don't wind up on restaurant plates, they usually end up back in their own dens. Lohmann demonstrated this by capturing lobsters in the Florida Keys, driving them to a marine lab 23 miles away, and doing everything possible to confuse them along the way. He covered their eyes and sealed them in dark plastic containers. He hung swinging magnets above them. He even drove erratically. And yet, once the lobsters were released, they walked off in the exact direction that would take them home.

*9 The geomagnetic field changes very slightly from year to year, which affects the magnetic signatures of turtle nesting beaches. Lohmann found that in years when the signatures of adjacent beaches converge on each other, nesting turtles crowd together. In years when the signatures diverge, the turtles spread out. These slight variations aren't enough to throw the animals significantly off course, though.

*10 When I visit his lab in Raleigh, North Carolina, he is caring for 16 baby loggerheads that were collected in September and will be released the following June. Each year's cohort of turtles is named with a different theme, and this year's is pasta. Lasagne, Ziti, Bowtie, and—my favorite—Turtellini are all swimming around their tanks.

*11 For decades, many scientists were sure that they had found magnetite-loaded neurons in the beaks of pigeons and other birds. When David Keays started working on magnetoreception, his plan was to study those neurons. But despite using "every method we could think of," he tells me, he couldn't find any. In 2012, Keays published a bombshell study showing that the alleged magnetite neurons that others had found aren't neurons at all. They're macrophages, a type of white blood cell. And while they do contain iron, it isn't in the form of magnetite. That same year, another team developed what looked like a surefire way of identifying magnetite-based receptors. Under a microscope, they saw that some cells in the nose of a trout would spin when placed in a rotating magnetic field. These spinning cells must be magnetic, and they seemed to contain deposits of magnetite. But Keays debunked this finding, too. He showed that the spinning cells just have flecks of iron stuck to their surfaces. They weren't magnetoreceptors. They were just dirty.

*12 It's also notable that, in 2011, Le-Qing Wu and David Dickman identified neurons in a pigeon's brain that respond to magnetic fields, and that are connected to the inner ear.

*13 Here's the longer version. When light hits the two partner molecules, one donates an electron to the other, leaving both of them with an unpaired electron. Molecules with unpaired electrons are called radicals: hence, the radical pair. Electrons have a property called spin, whose exact nature we can leave to the quantum physicists. What matters to biologists is that spin can either be up or down; the radical pair can either have the same spins or opposite ones; they flip between these two states several million times a second; and the magnetic field can change the frequency of these flips. So depending on the magnetic field, the two molecules end up in one state or another, which in turn affects how chemically reactive they are.

*14 I interviewed Klaus Schulten in 2010, well before I had the idea for this book. Schulten died in 2016.

*15 These wavelengths have exactly the right amount of energy to turn cryptochrome and flavin into a radical pair. Under red light alone, a bird's compass doesn't work.

*16 Mouritsen has been a birdwatcher since he was 10 years old, and he has seen more than 4,000 species in his lifetime. He originally wanted to be a high school teacher because the vacations were long and would allow him to go on extended birding trips. And even though he ended up as a biology professor, "when I have time to go out, I'm still a birdwatcher," he says. "That's what I miss the most in this coronavirus time: I can't travel anywhere." It is an ironic turn of events for someone who studies animals that migrate over continents.

*17 Robins are nocturnal migrants, so it's odd that they should rely on a light-activated compass. But even at night, there's always a bit of light around. Theoretical calculations suggest that even a moonless and slightly cloudy night has enough light to activate the compass.

*18 Even if the radical pair idea is the only correct one, it leaves many unanswered questions. Birds have several cryptochromes, so which is involved in the compass? (One called Cry4 has emerged as a frontrunner; robins mass-produce it during the migratory season, and specifically within the cone cells of their retinas.) How do the final steps of the radical pair dance get converted into a nervous signal? How do the birds separate magnetic information from what they normally see? And why, as Mouritsen showed, can a bird's compass be disrupted by the extremely weak radiofrequency fields of the kind produced by certain electrical equipment or used in AM radio? Such fields carry no useful information and have only become commonplace in the last century of human activity. Birds can't have evolved the ability to sense them—so why are they affected? "We must be missing something major that makes the sensor

much more sensitive than we think it should be," says physicist Peter Hore. "This means that our theories aren't fully developed. We haven't come up with the definitive experiment." He and Mouritsen are trying, though. They have started an ambitious project, whose details Hore only tells me about on the strict understanding that I don't write about them.

*19 This flawed experiment aside, there is good evidence that honeybees can sense magnetic fields.

*20 There's even controversy about whether humans have a magnetic sense. In the 1980s, British zoologist Robin Baker drove blindfolded undergraduates on winding routes before asking them to point the way home. They did so more often than expected, but not if they wore magnets on their heads. Baker published his results in *Science,* one of the world's premier journals. But while he repeatedly found the same results, others could not. "We are forced to wonder about the ecological importance of a magnetic sense, the existence of which is so difficult to demonstrate," one duo wrote. More recently, geophysicist Joseph Kirschvink, who was a vocal critic of Baker's experiments, showed that certain brain waves in human volunteers change when an artificial magnetic field is rotated around them. Kirschvink has taken this to mean that humans have magnetoreception. Others aren't convinced. "I guess I can only speak for myself, but I absolutely cannot detect magnetic fields," Keays tells me. "I use an iPhone with a nice compass app, and that's my magnetoreceptor." Kirschvink has argued that humans are unconsciously aware of magnetic stimuli, but he still needs to show that said awareness is useful in some way. Otherwise, so what? Why would it matter for us to have a sense that we are unaware of and that we don't use for anything?

*21 To be clear, the early songbird experiments from the 1950s and 1960s, which confirmed that these animals have a magnetic compass, are solid. Those same results have been replicated by many labs, working with many species.

*22 Both echolocation and electroreception were discovered at roughly the same time, but neither is plagued by anywhere near the level of irreproducible or controversial results as magnetoreception.

12.

Every Window at Once

Uniting the Senses

I'M TRYING TO CONVINCE MYSELF that I'm not really itchy. It's just that I'm surrounded by tens of thousands of mosquitoes. They all belong to the same species—*Aedes aegypti,* which is responsible for spreading Zika, dengue, and yellow fever. Mercifully, in the small, sealed room in which I'm standing, the insects are all restrained in white mesh cages. Neuroscientist Krithika Venkataraman pulls one of these cages off a shelf and sets it on the table next to us while she tells me how mosquitoes track their hosts. After talking to her for a few minutes, I look down at the cage and notice, to my horror, that almost all the mosquitoes inside are now perched on the side that's closest to us. They're probing through the mesh with their bloodsucking snouts, which look like a field of black hairs, erupting and subsiding. My itch intensifies. Venkataraman tells me that the mosquitoes are drawn to the carbon dioxide in our breath and the odors emanating from our skin. They can smell us. To demonstrate this, she picks up a different cage, and I exhale along one side of it. Within minutes, almost all the mosquitoes have swarmed onto that side and are probing away.

Leslie Vosshall, who runs the lab where Venkataraman works, spent years trying to protect people from *Aedes aegypti* by befuddling its olfactory abilities. First, she tried to disable a gene called *orco,* which seems to underlie a mosquito's entire sense of smell. This approach worked

when Daniel Kronauer, who works down the hall from Vosshall, tried it in clonal raider ants, as we saw earlier. But it failed when Vosshall tried it on mosquitoes: Without *orco,* they ignored human body odor but they were still drawn to carbon dioxide. Switching tactics, Vosshall's team tried to create mutant mosquitoes that could no longer smell carbon dioxide. That didn't work either: The insects could still easily home in on humans. "The results kinda sucked," Vosshall tells me.

Mosquitoes can't be thrown off with any one strategy because they aren't beholden to any one sense. Instead, they use a multitude of cues that interact in complicated ways. They're attracted to the heat of warm-blooded hosts, but only if they first smell carbon dioxide. When Vosshall's student Molly Liu placed the insects in a chamber and slowly heated one of the walls, most of them had buzzed off by the time the surface hit human body temperature. But if Liu sprayed a puff of carbon dioxide into the chamber, the mosquitoes swarmed the hot wall and stayed there. In carbon dioxide's absence, heat is repulsive and a sign of danger. In its presence, heat is attractive and a sign of a meal.[*1] Vosshall still believes she can find a way of cloaking humans from mosquitoes, but she'll need to consider many senses at once—smell, vision, heat, taste, and more. *Aedes aegypti* has "a plan B at every point," she tells me.[*2]

The mosquito's senses have been honed over millennia of evolution. *Aedes aegypti* originally hailed from forests in sub-Saharan Africa, where it drank from a wide variety of animals. But thousands of years ago, one particular lineage got a taste for humans, who had recently started living in densely populated settlements. Drawn to these sites, *Aedes aegypti* transformed into an urban animal that prefers

towns over forests, and a parasite whose Umwelt is tuned to the distinctive cues of our bodies above all else. This mosquito is now among the planet's most effective hunters of humans, and it is extremely picky about anything else. That's why, to feed captive mosquitoes, scientists like Venkataraman often just stick their arms inside their insect cages. "It takes about 10 minutes," she says. "I don't do it regularly, so I still react to the bites, but if you don't scratch, it's fine." It's hard to imagine not scratching.

Imagine, instead, what it might be like to be a mosquito. Flying through a thick soup of tropical air, your antennae slice through plumes of odorants until they catch a whiff of carbon dioxide. Enticed, you turn into the plume, zigzagging when you lose track of it, and surging ahead whenever you pick it up. You spot a dark silhouette and fly over to investigate. You enter into a cloud of lactic acid, ammonia, and sulcatone—molecules released by human skin. Finally, the clincher: an alluring burst of heat. You land, and your feet pick up an explosion of salt, lipids, and other tastes. Your senses, working together, have once again found a human. You find a blood vessel and drink your fill.

In the introduction, we saw that Jakob von Uexküll, pioneer of the Umwelt concept, once compared an animal's body to a house, with many sensory windows overlooking an outlying garden. Over the subsequent 11 chapters, we peered through each of those windows one by one, to better understand what makes each sense unique. Many sensory biologists do the same, looking through a single window over their entire careers. Animals don't. Like the *Aedes* mosquitoes, they combine and cross-reference the information from all of their senses at once. We must follow their lead. To truly appreciate their Umwelten, and to bring

our voyage through the senses to a close, we have to consider Uexküll's metaphorical house in its entirety. We must study the architecture of the house itself to see how the form of an animal's entire body defines the nature of its Umwelt. We have to look within the house to see how animals combine the sensory information from the outside world with that from inside their own bodies. And we have to gaze through every window at once, to see how animals use their senses together.

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EACH SENSE HAS pros and cons, and each stimulus is useful in some circumstances and useless in others. That's why animals tap into as many streams of information as their nervous systems can handle, using the strengths of one sense to compensate for the shortcomings of another. No species uses a single sense to the exclusion of every other. Even animals that are paragons of one sensory domain have several at their disposal.

Dogs are masters of smell, but note their large ears. Owls are masters of hearing, but note their large eyes. Jumping spiders depend on their large eyes, but they're also sensitive to surface vibrations traveling through their feet and to airborne sounds that deflect their sensitive, body-wide hairs. Seals use their whiskers to track the hydrodynamic wakes of fish, but their eyes and ears also help them to hunt. The star-nosed mole hunts along its tunnels using touch, but it can also forage underwater, blowing bubbles out of its star and re-inhaling them to detect the odors of prey. Smell dominates the lives of ants, but sounds matter enough that some parasites can inveigle their way into ant nests by mimicking the noises of queens.

Smells also guide sharks to their food over mile distances, but vision and the lateral line take over as the distance diminishes, and the electric sense chips in during the final moments of a strike. The Ubangi elephantnose fish creates electric fields to detect small objects close to its body, but its eyes are tuned to spotting large, fast-moving objects like predators that lie beyond the range of its electric sense. Songbirds and bogong moths use Earth's magnetic field to tell them where to go, but they also depend on celestial sights to guide their migrations. Daniel Kish echolocates when he walks around his neighborhood, but he also uses a long cane.

Beyond complementing each other, the senses can also combine. Some people experience synesthesia, where different senses seem to bleed into one another. To some synesthetes, sounds might have textures or colors. To others, words might have tastes. This perceptual blurring is special among humans, but standard to other creatures. The platypus's duck-like bill, for example, contains some receptors that detect electric fields, and others that are sensitive to touch. But in its brain, the neurons that receive signals from the former also receive signals from the latter. The platypus might just have a single sense of electrotouch. As it dives in search of food, it might detect the electric field that a crayfish generates before sensing the flowing water that it stirs up. Some researchers have suggested that the platypus uses the time lag between these signals to judge how far away the crayfish is, just as we can gauge the distance to a storm by the gap between lightning and thunder.

Mosquitoes, meanwhile, have neurons that seem to respond to both temperatures and chemicals. I ask Leslie Vosshall if this means the insects can taste body heat. She

shrugs. “The simplest way to sense the world would be to have the senses be separate—to have neurons that taste, or smell, or see,” she tells me. “Everything would be very tidy. But the more we look, the more we see that a single cell can do multiple things at the same time.” For example, the antennae of ants and other insects are organs of both smell and touch. In an ant’s brain, “ these probably fuse to produce a single sensation,” wrote entomologist William Morton Wheeler in 1910. Imagine if we had delicate noses on our fingertips, he suggested. “If we moved about, touching objects to the right and left along our path, our environment would appear to us to be made up of shaped odors, and we should speak of smells that are spherical, triangular, pointed, etc. Our mental processes would be largely determined by a world of chemical configurations, as they are now by a world of visual (i.e., color) shapes.”

Even when the senses don’t fuse, they can converge. As we saw in Chapter 9, a dolphin can visually recognize a hidden object that it had previously scanned using echolocation, using one of its senses to build mental representations that are accessible to the others. This feat is called cross-modal object recognition, and it’s not limited to big-brained species like dolphins and humans. Electric fish that learn to visually distinguish between crosses and spheres can also tell them apart with their electric sense (and vice versa). Even bumblebees can tell objects apart using touch after learning the visual differences between them.

Some senses also look inward, informing animals about the state of their bodies. There’s proprioception, the awareness of the body’s position and movement. There’s equilibrioception, the sense of balance.[*3] These internal senses are seldom discussed. Aristotle left them out of his

five-sense classification, and I have largely ignored them on this journey through nature's Umwelten. But that's not because they are unimportant. It's because they're so important that we take them for granted. We can get by without vision or hearing, but internal senses are non-negotiable. In telling animals about themselves, they help them to make sense of everything else. And they're especially important because animal bodies do something that Uexküll's metaphorical houses do not.

They move.

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WHEN ANIMALS MOVE, their sense organs provide two kinds of information. There's *exafference,* signals produced by stuff happening in the world. There's also *reafference,* signals produced by an animal's own actions. I still struggle to remember the difference between these, and if you share that problem, you can think of them as other-produced and self-produced. From my desk, I can see the branches of a tree rustling in the wind. That's exafference—other-produced. But to see those branches, I had to look to my left—a sudden, jarring movement that sent patterns of light sweeping across my retinas. That's reafference—self-produced. Every animal, for each of its senses, has to distinguish between these two kinds of signals. But here's the catch: These signals *are the same* from the point of view of the sense organs.

Consider a simple earthworm. When it burrows through the soil, the touch receptors in its head register pressure. But if you prod the worm in the head, the same touch receptors register the same kind of pressure. So how does the worm know if a given sensation comes from its own

movement (reafference) or someone else's (exafference)? How does it know if it is touching something, or if it has been touched? Similarly, if a fish's lateral line detects flowing water, is that because something is swimming toward it, or because it is itself swimming? If you see movement, is that because something around you moved or because your eyes did? If an animal can't tell other-produced signals from self-produced ones, its Umwelt would be an unintelligible mess.

This problem is so fundamental that very different creatures have solved it in the same way.[*4] When an animal decides to move, its nervous system issues a motor command—a set of neural signals that tell its muscles what to do. But on its way to the muscles, this command is duplicated. The copy heads to the sensory systems, which use it to simulate the consequences of the intended movement. When the movement actually occurs, the senses have already predicted the self-produced signals that they are about to experience. And by comparing that prediction against reality, they can work out which signals are actually coming from the outside world and react to them appropriately.[*5] All of this happens unconsciously, and while it isn't intuitive, it is central to our experience of the world. The information detected by the senses is always a mix of self-produced (reafference) and other-produced (exafference), and animals can tell the two apart because their nervous systems are constantly simulating the former.

Philosophers and scholars have speculated about this process for centuries. In 1613, the Belgian physicist François d'Aguilon wrote that "an internal faculty of the soul perceives the movement of the eye." In 1811, German physician Johann Georg Steinbuch wrote about *Bewegideen,* or "motion ideas"—brain signals that control

movements and that interact with sensory information. In 1854, another German physician, Hermann von Helmholtz, referred to the *Bewegidee* as *Willensanstrengung,* or "effort of will." As of 1950, the duplicated motor commands have been called *efference copies* or—my favorite of these terms—*corollary discharges*.[*6] There are subtle differences between these terms, but the underlying idea is the same. Whenever an animal moves, it unconsciously creates a mirror version of its own will, which it uses to predict the sensory consequences of its actions. With every action, the senses are forewarned about what to expect and can prepare themselves accordingly.

Scientists have learned a lot about corollary discharges from studying elephantfish, which use them to coordinate their electric senses. As we saw in Chapter 10, they have three different kinds of electroreceptors. One set detects the elephantfish's own electric pulses. A second detects the communicative signals of *other* elephantfish. And a third detects the weaker electric fields produced by potential prey.[*7] The second and third groups can only work if they ignore the fish's own electric pulses, and they do so through corollary discharges. These are created whenever the electric organ fires, and they prep parts of the brain that receive signals from the second and third groups of receptors to ignore the fish's own pulses. In this way, an elephantfish can tell which signals are being passively produced by potential prey, which are being actively produced by other electric fish, and which are being actively produced by itself.

Electric fish are exceptional creatures, but "almost all animals have some mechanism that's more or less like this," Bruce Carlson tells me. Corollary discharges explain why you can't tickle yourself: You automatically predict the

sensations that your writhing fingers would produce, which cancels out the actual sensations that you feel. They're why your view is stable even though your eyes are constantly darting around.[*8] They're how chirping crickets can block out the sounds of their own calls. They're why fish can sense the flows created by other fish without being confused by their own swimming, and why earthworms can crawl ahead without reflexively recoiling.[*9]

These feats are so profound that they don't feel like feats at all. It feels self-evident that we own our bodies, that we exist within the world, and that we can tell the former from the latter. But these are not axiomatic properties. Distinguishing self from other isn't a given; it's a difficult problem that nervous systems have to solve. "This is largely what sentience is," neuroscientist Michael Hendricks tells me. "And perhaps it's *why* sentience is: It's the process of sorting perceptual experiences into self-generated and other-generated."

That sorting process doesn't require consciousness, or any advanced mental abilities. "It isn't some fancy, late-added thing in evolution," Hendricks says. It exists in nervous systems with a few hundred neurons and those with tens of billions. It's a foundational condition of animal existence, which flows from the simplest acts of sensing and moving. Animals cannot make sense of what's around them without first making sense of themselves. And this means that an animal's Umwelt is the product not just of its sense organs but of its entire nervous system acting in concert. If the sense organs acted alone, nothing would make sense. Throughout this book, we have explored the senses as separate parts. But to truly understand them, we need to think about them as part of a unified whole.

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IN JUNE 2019, during a panel discussion on animal intelligence at the World Science Festival, psychologist Frank Grasso brought a two-spot octopus named Qualia onto the stage. He then offered the animal a black-lidded jar containing a tasty crab. He hoped that she would unscrew the lid and extract the crab—a party trick that many octopuses are capable of, and that's often offered as evidence for their intelligence. Qualia had unscrewed many jars in her time, but Grasso warned the audience that she may instead "decide to have a little pout and hang out in the corner." Sure enough, that's what she did. She's still doing that a month later, when I visit Grasso at his New York lab.

Qualia used to swim to the front of her tank when strangers entered, but in her old age, she hunches in a corner. Ra, another two-spot octopus, has taken her place as the lab's attention hog. She's actively sidling across her tank, suckers pressing against the glass. Two of Grasso's undergraduate students drop a jar with a crab into her tank, and she quickly descends upon it. The web of her arms envelops the lid, her skin darkens in color…and then nothing happens. She seems to lose interest and jets off. Later, she extends a single arm and touches the jar but then retracts it. The lid remains unscrewed; the crab, uneaten. "There was a time when both these animals were avidly opening bottles," Grasso tells me. But now they don't bother. They'll readily pounce upon a loose crab, and they can certainly get at the bottled ones. They just don't. Grasso now wonders if the octopuses can even see the bottled crabs at all. "It might be that all the jar opening that we've been seeing is a result of them just being

curious about this novel object," he tells me, and "they can't see through the rounded glass to know if there's a crab in there."

To work out why an octopus would unscrew a jar and why they would stop, we need to understand their Umwelt. We can start by exploring their eyes, their suckers, and their other sense organs in turn. But we must then understand how the octopus's entire nervous system works, how it controls a body of almost unfettered flexibility, and how its brain and body combine to create not just one Umwelt but arguably two.

An octopus's central nervous system contains around 500 million neurons—a total that dwarfs that of all other invertebrates and that's comparable to the number found in small mammals.[*10] But only a third of these neurons are located in the animal's head, within the central brain and the adjacent optic lobes that receive information from the eyes. The remaining 320 million are in the arms. Each arm "has a large and relatively complete nervous system, which seems barely to communicate with the other arms," Robyn Crook once wrote. " An octopus effectively has nine brains that have their own agendas."

Even the 300 suckers on each arm are somewhat independent. Once a sucker makes contact with something, it reshapes itself to create a seal and then sticks by creating suction. Meanwhile, it simultaneously touches and tastes using 10,000 mechanoreceptors and chemoreceptors on its rim. Our tongues perceive flavor and mouthfeel as separate qualities, but given the wiring of the sucker, an octopus likely doesn't. Its sensations of taste and touch "are probably inextricably fused" in a way that resembles synesthesia, Grasso tells me. Depending on the flavors it feels, or the textures it tastes, the sucker might continue

sucking or let go. And it can make that decision on its own, since each sucker is served by its own mini-brain—a dedicated cluster of neurons called the sucker ganglion. The suckers' independence is obvious when watching disembodied arms, which are often found stuck to the sides of fish, but will never stick to other arms from the same octopus.

Each sucker ganglion connects to another cluster of neurons in the center of the arm called the brachial ganglion. All the brachial ganglia are then connected in a long row running down the arm: Think of them as a string of fairy lights, and the sucker ganglia as their bulbs. The sucker ganglia don't communicate with each other, but the brachial ganglia do.[*11] They coordinate the individual suckers and allow the entire arm to act in an organized way. And they can also accomplish a lot on their own, without involving the central brain. The arm contains all the circuitry it needs to reach out, grab objects, and pull them back in. For example, neurobiologist Binyamin Hochner found that when the arm touches an object, two waves of neural signals travel down its length, one from the contact point and one from the base. Where these waves meet, the arm forms a temporary elbow, bending to draw the object toward the octopus's mouth. "There's so much information and behavior that's stored in the arms," Grasso tells me.[*12]

The central brain *can* control the arms, but it's a relaxed boss. It doesn't like to micromanage but coordinates its team of eight when needed. A single arm can snake its way through an opaque maze, using taste-touch to find the right route with no input from the rest of the animal. But Hochner's colleague Tamar Gutnick has shown that octopuses can also solve problems that stump individual

arms. She set up a transparent maze in which the correct path forced the arm out of the water, depriving it of chemical cues. The octopuses could still find that path by guiding their arms with their eyes, but it didn’t come naturally to them. It took a while for them to learn how to do it, and one individual out of seven never did.

Letizia Zullo, another member of Hochner’s team, found more evidence of the arms’ autonomy in the way the central brain is organized. The human brain contains rough maps of the body. Tactile sensations from different body parts, like each finger, are processed by separate clusters of neurons. Similarly, distinct parts of the brain drive specific movements: Stimulate the right spot, and your arm might rise or your hand might reach out. But Zullo found that the octopus has no such maps. Whenever she stimulated a part of the brain that made one arm extend, other arms would stretch out, too. Would an octopus be aware if the twentieth sucker on its first arm touches a crab, just as I know when my right index finger has just pressed the Y key? Maybe not! It’s possible that the animal simply knows that arm number one has found food, while delegating the specifics to the arm itself. Does an octopus even know where its limbs are, just as I can visualize my body without looking at it? Again, maybe not! The arms certainly contain proprioceptors, which help them to coordinate their movements, but that coordination might be entirely local. Martin Wells, a late pioneer of octopus research, was convinced that these animals don’t really have a sense of where their limbs are, or an internal image of their shape.

Perhaps that’s just as well. Controlling a human body is relatively simple for a human brain because our bones and joints constrain our movements. There are only so many

ways in which, for example, you can pick up a mug. But as philosopher Peter Godfrey-Smith wrote in *Other Minds,* an octopus has " a body of pure possibility." Aside from its hard beak, it is soft, malleable, and free to contort. Its skin can change color and texture at a whim. Its arms can extend, contract, bend, and rotate anywhere along their lengths, and have practically infinite ways of performing even simple movements. How could a brain, even a large one, keep track of such boundless options? The question turns out to be irrelevant. The brain doesn't have to. It can mostly let the arms sort themselves out, while imposing the occasional guiding nudge.[*13]

The octopus, then, arguably has *two* distinct Umwelten. The arms live in a world of taste and touch. The head is dominated by vision. There's undoubtedly some cross-talk between these sides, but Grasso suspects that the information exchanged between the head and the arms is simplified. To extend Uexküll's metaphor of animal bodies as houses with sensory windows, the octopus's body consists of two semidetached houses with utterly different architectural styles and a small connecting door between them. Never mind what it's like to be a bat, as Nagel pondered. How can we possibly know what it is like to be an octopus? Its unusual senses challenge our imagination, but so does the way it brings those senses together. Its component threads are unfamiliar, the weave is exotic, and the tapestry that results is utterly alien.

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THE ACT OF sensing creates an illusion that, ironically, makes it harder to appreciate how the senses work. When I looked at Qualia and Ra, I didn't have any conscious

awareness of the photoreceptors firing in my eyes. I simply saw. When I touched their tanks, I didn't feel the mechanoreceptors in my fingers reacting to pressure. I simply felt. Our experiences of the world feel disconnected from the very sense organs that produce them, which makes it easy to believe that they are purely mental constructs divorced from physical reality. That's why our stories and myths are so full of characters who can transfer their consciousness into the bodies of animals—the Norse god Odin, for example, or Bran from the once-popular series *Game of Thrones.* Such feats, in which humans literally step into the sensory worlds of other animals, feel like the ultimate form of Umwelt-appreciation. But they also fundamentally misunderstand the concept. An animal's sensory world is the result of solid tissues that detect real stimuli and produce cascades of electrical signals. It is not separate from the body, but of it. You can't simply imagine how a human mind would work in a bat's body or an octopus's, because it *wouldn't work*.

When Qualia and Ra began opening crab-filled jars, they looked like they were deliberately solving a problem in pursuit of a goal. But were their central brains even involved, or were their arms simply exploring new objects on their own? If the latter is true, is their behavior any less intelligent than it seemed, or does the octopus's intelligence manifest through the autonomous curiosity of its limbs? (Can an octopus's arms be curious?) When Qualia and Ra stopped opening those jars, were *they* getting bored or were *their arms*? (Can an octopus's arms get bored?) Was there some conflict between their dual Umwelten—between what their eyes were seeing and what their arms were feel-tasting?

These questions are extraordinarily hard to answer, but they become impossibly hard if we look at each part of the octopus separately. The workings of its suckers or its eyes can't tell us what the whole animal perceives. The movements of its body can be easily misinterpreted without knowing the structure of its nervous system. This is why Nagel's challenge about imagining another creature's conscious experience is so vexing: To stand any chance of knowing what it is like to be another animal, we need to know almost everything about that animal. We need to know about all of its senses, its nervous system and the rest of its body, its needs and its environment, its evolutionary past and its ecological present. We should approach this work humbly, recognizing how easily our intuitions can lead us astray. We should move forward hopefully, knowing that even a partially successful attempt will reveal wonders that were previously hidden to us. And we should act quickly, knowing that our time is running out.

SKIP NOTES

*1 Our senses undergo similar flips. If you show someone a picture of a dirty sock and let them sniff isovaleric acid, they'll find it disgusting, but pair the same chemical with a picture of fine Époisses cheese and it'll smell delectable.

*2 After all, that's likely what DEET does. Developed by the U.S. Department of Agriculture in 1944, DEET has a long history of initially protecting troops in tropical countries and then civilians around the world. It works—but no one really knows why. Vosshall originally suspected that it blocks *orco* but now thinks that it bamboozles mosquitoes' sense of smell (and taste) in more complicated ways. If she can duplicate this effect, she hopes to find substances that are more effective than DEET, longer-lasting, and safer for infants.

*3 Millions of people live perfectly well without vision, smell, or hearing. But to lose proprioception is far more debilitating. In 1971, a 19-year-old butcher

named Ian Waterman came down with an infection, which triggered an autoimmune attack that robbed him of proprioception. Without feedback from his limbs, he could no longer coordinate his movements. He wasn't paralyzed, but he couldn't stand or walk. If he couldn't see his body, he didn't know where it was. Only after 17 months of intense training did Waterman relearn how to move his body using visual control.

*4 Technically, it's a problem shared only by animals that move. If you are completely immobile, you can be pretty sure that any information from your sense organs is produced by changes in the outside world rather than your own actions. But no animals are completely immobile; even sponges, which have no nervous systems and sit anchored onto rocks, can expel waste from their bodies by "sneezing."

*5 It's frankly astonishing that this works. Look to your left. Your brain just sent a simple signal that told some of the muscles around your eyeball to contract. How did your nervous system then use that signal to predict how the scene around you would change? We know that it did, but the actual computations that occurred are still a mystery. "How do you go from a motor command to a signal that a sensory structure can work with?" Nate Sawtell, who works with electric fish, asks me. "That's the core problem."

*6 For a full history of these terms and the idea behind them, there's an excellent paper by Otto-Joachim Grüsser.

*7 For ampullary receptors and knollenorgans, as for most other sense organs, reafference is noise and exafference is the signal. But for tuberous receptors, which detect the fish's own signals, the opposite is true: Reafference is the signal and exafference is the noise.

*8 Corollary discharges apply to other senses, too. A brain area that controls the movement of your diaphragm sends signals to the olfactory bulb—the smell center of the brain. That bulb processes signals differently depending on whether you are inhaling or exhaling.

*9 Some scientists have suggested that schizophrenia is fundamentally a disorder of corollary discharges. People with the condition might experience hallucinations and delusions because they can't distinguish their own inner speech from the voices around them. A failure to sort self from other might also explain some of schizophrenia's stranger symptoms, like the ability to tickle yourself. Might there be schizophrenic elephantfish that can't tell their own discharges from those of other fish? "It's certainly possible," Carlson tells me. "I would expect dramatically disrupted behavior."

*10 In humans, the central nervous system includes everything in the brain and spine, while the peripheral nervous system includes the nerves in our limbs, organs, and other body parts. But in the octopus, this distinction breaks down. The nerves in the brachial and sucker ganglia are very much part of the central nervous system, even though they exist in the arms.

*11 Between them, each sucker ganglion and its corresponding brachial ganglion contain around 10,000 neurons. That's roughly as many as in an entire leech or sea slug. A single octopus arm contains roughly as many neurons as a lobster.

*12 In the 1950s and 1960s, Martin Wells removed large parts of the brain from some octopuses and showed that these "decerebrate" animals could still use their suckers to manipulate objects, open clamshells, and feed.

*13 Godfrey-Smith marvelously compares the central brain to a conductor and the arms to "jazz players, inclined to improvisation, who will accept only so much direction."

13.

Save the Quiet, Preserve the Dark

Threatened Sensescapes

Within the 310,000 acres of Wyoming's Grand Teton National Park, the largest piece of human-made infrastructure is a parking lot at the village of Colter Bay. Beyond its far edge, nestled among some trees, is a foul-smelling sewage-processing building that Jesse Barber calls the Shiterator. Beneath its metal awning, sitting quietly within a crevice and illuminated by Barber's flashlight, there is a little brown bat. And on the bat's back, there is a white device the size of a rice grain. "That's the radio tag," Barber tells me. He'd previously affixed it to the bat so that he could track its movements. He has returned tonight to tag a few more.

From inside the Shiterator, I can hear the chirps of other roosting bats. As the sun sets, they start to emerge. Navigating more through memory than echolocation, they fail to notice the large mist net that Barber has strung between two trees. A few become entangled. Barber frees them, and his students Hunter Cole and Abby Krahling carefully examine each one to check that they're healthy and heavy enough to carry a tag. One individual opens its mouth, filling the air with a stream of sonar pulses that I can't hear. Cole daubs a spot of surgical cement between its shoulder blades. He attaches the tiny tag, and waits for the cement to dry. "It's a little bit of an art project, the tagging of a bat," Barber tells me. After a few minutes, Cole places the bat on the trunk of the nearest tree. It

crawls upward and takes off, carrying $175 worth of radio equipment into the woods.

As the hours wear on, the darkness intensifies. The echolocating bats don't mind. Neither does the sharp-eared owl that flies overhead, nor the carbon-dioxide-tracking mosquitoes that bite me through my shirt. But Barber and his students can only continue their work using their headlamps, whose beams have attracted clouds of insects. Ironically, that's why Barber is here. He's one of a growing number of sensory biologists who fear that humans are polluting the world with too much light, to the detriment of other species. Even here, in the middle of a national park, light intrudes upon the darkness. It spews forth from the headlamps of passing vehicles, from the fluorescent bulbs of the visitor center, and from the lampposts encircling the parked cars. "The parking lot is lit up like a Walmart because no one thought about the implications for wildlife," Barber tells me.

Through centuries of effort, people have learned much about the sensory worlds of other species. But in a fraction of the time, we have upended those worlds. We now live in the Anthropocene—a geological epoch defined and dominated by the deeds of our species. We have changed the climate and acidified the oceans by releasing titanic amounts of greenhouse gases. We have shuffled wildlife across continents, replacing indigenous species with invasive ones. We have instigated what some scientists have called an era of "biological annihilation," comparable to the five great mass extinction events of prehistory. And amid this already dispiriting ledger of ecological sins, there is one that should be especially easy to appreciate and yet is often ignored—sensory pollution. Instead of stepping into the Umwelten of other animals, we have forced them to live

in ours by barraging them with stimuli of our own making. We have filled the night with light, the silence with noise, and the soil and water with unfamiliar molecules. We have distracted animals from what they actually need to sense, drowned out the cues they depend upon, and lured them, like moths to a flame, into sensory traps.

Many flying insects are fatally attracted to streetlights, mistaking them for celestial lights and hovering below them until they succumb to exhaustion. Some bats exploit their confusion, feasting on the disoriented swarms. Other, slow-moving species, like the little brown bats that Barber tagged, stay clear of the light, perhaps because it makes them easier prey for owls. Lights reshape the animal communities around them, drawing some in and pushing others away, with consequences that are hard to predict. Could the light-averse bats do badly because their habitable zones have shrunk and their insect prey have been pulled away? Might the light-attracted bats temporarily benefit but eventually suffer as the local insect populations crash? To find out, Barber convinced the National Park Service to let him try an unusual experiment.

In 2019, he refitted all 32 streetlights in the Colter Bay parking lot with special bulbs that can change color. They can either produce white light, which strongly affects the behavior of insects and bats, or red light, which doesn't seem to.[*1] Every three days, Barber's team flips their color. Funnel-shaped traps hanging below the lamps collect the gathering insects, while radio transponders pick up the signals from the tagged bats. These data should reveal how normal white lights affect the local animals, and whether red lights can help to rewild the night sky.

Cole gives me a little demonstration by flipping the lights to red. At first, the parking lot looks disquietingly

infernal, as if we have stepped into a horror movie. But as my eyes adjust, the red hues feel less dramatic and become almost pleasant. It is amazing how much we can still see. The cars and the surrounding foliage are all visible. I look up, and notice that fewer insects seem to be gathered beneath the lamps. I look up even further, and see the stripe of the Milky Way, cutting across the sky. It's an achingly beautiful sight, which I have never before seen in the Northern Hemisphere.

In 2001, when astronomer Pierantonio Cinzano and his colleagues created the first global atlas of light pollution, they calculated that two-thirds of the world's population lived in light-polluted areas, where the nights were at least 10 percent brighter than natural darkness. Around 40 percent of humankind is permanently bathed in the equivalent of perpetual moonlight, and around 25 percent constantly experiences an artificial twilight that exceeds the full moon. " 'Night' never really comes for them," the researchers wrote. In 2016, when the team updated their atlas, they found that the problem was even worse. By then, around 83 percent of people—and more than 99 percent of Americans and Europeans—were living under light-polluted skies. Every year, the proportion of the planet covered by artificial light gets 2 percent bigger and 2 percent brighter. A luminous fog now smothers a quarter of Earth's surface and is thick enough in many places to blot out the stars. Over a third of humanity, and almost 80 percent of North Americans, can no longer see the Milky Way. " The thought of light traveling billions of years from distant galaxies only to be washed out in the last billionth of a second by the glow from the nearest strip mall depresses me no end," vision scientist Sonke Johnsen once wrote.

At Colter Bay, Cole flips the lights back to white, and I wince. The extra illumination feels harsh and unpleasant. The Milky Way seems fainter now, and consequently, the world feels smaller. Sensory pollution is the pollution of disconnection. It detaches us from the cosmos. It drowns out the stimuli that link animals to their surroundings and to each other. In making the planet brighter and louder, we have also fragmented it. While razing rainforests and bleaching coral reefs, we have also endangered sensory environments. That must now change. We have to save the quiet, and preserve the dark.

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EVERY YEAR, ON September 11, the sky above New York City is pierced by two columns of intense blue light. This annual art installation, known as Tribute in Light, commemorates the terrorist attacks of 2001, with the ascending beams standing in for the fallen Twin Towers. Each is produced by 44 xenon bulbs with 7,000-watt intensities. Their light can be seen from 60 miles away. From closer up, onlookers often notice small flecks, dancing amid the beams like gentle flurries of snow. Those flecks are birds. Thousands of them.

This annual ritual unfortunately occurs within the autumn migratory season, when billions of small songbirds undergo long flights through North American skies. Navigating under cover of darkness, they fly in such large numbers that they show up on radar. And by analyzing radar images, Benjamin van Doren showed that the Tribute in Light, across seven nights of operation, waylaid around 1.1 million birds. The beams reach so high that even at altitudes of several miles, passing birds are drawn into

them. Warblers and other small species congregate within the light at densities up to 150 times their normal levels. They circle slowly, as if trapped within an incorporeal cage. They call frequently and intensely. They occasionally crash into nearby buildings.

Migrations are grueling affairs that push small birds to their physiological limit. Even a nightlong detour could prematurely sap their energy reserves to fatal effect. So whenever a thousand birds or more are caught within the Tribute in Light, the bulbs are turned off for 20 minutes to let them regain their bearing. But that's just one source of light among many, and though intense and vertical, it only shines once a year. At other times, light pours out of sports stadia and tourist attractions, oil rigs and office buildings. It pushes back the dark and pulls in migrating birds. In 1886, shortly after Edison commercialized the electric lightbulb, nearly 1,000 birds died after colliding with an electrically illuminated tower in Decatur, Illinois. Over a century later, environmental scientist Travis Longcore and his colleagues calculated that almost 7 million birds a year die in the United States and Canada after flying into communication towers.[*2] The red lights of those towers are meant to warn aircraft pilots, but they also disrupt the orientation of nocturnal avian fliers, which then veer into wires or each other. Many of these deaths could be avoided simply by replacing steady lights with blinking ones.

"We too quickly forget that we don't perceive the world in the same way as other species, and consequently, we ignore impacts that we shouldn't," Longcore tells me. Our eyes are among the sharpest in the animal kingdom, but their high resolution comes with the inescapable cost of low sensitivity. Unlike most other mammals, our vision fails us at night, and our culture reflects our diurnal Umwelt.

Light has come to symbolize safety, progress, knowledge, hope, and good. Darkness epitomizes danger, stagnation, ignorance, despair, and evil. From campfires to computer screens, we have craved more light, not less.[*3] It is jarring for us to think of light as a pollutant, but it becomes one when it creeps into times and places where it doesn't belong.

Many of the other planetary changes we have wrought have natural counterparts: Modern climate change is unquestionably the result of human influence, but the planet's climate does change naturally over much slower timescales. Light at night, however, is a uniquely anthropogenic force. The daily and seasonal rhythms of bright and dark remained inviolate throughout all of evolutionary time—a 4-billion-year streak that began to falter in the nineteenth century. Astronomers and physicists were among the first to talk about light pollution, which dimmed their view of the stars. Biologists only started seriously paying attention in the 2000s, Longcore tells me.[*4] In part, that's because biologists are themselves diurnal. At night, while they sleep, the dramatic changes that occur around them go unstudied. But "the problem is right in front of you once you open your eyes to look for it," Longcore says.

When sea turtle hatchlings emerge from their nests, they crawl away from the dark shapes of dune vegetation toward the brighter oceanic horizon. But lit roads and beach resorts can steer them in the wrong direction, where they are easily picked off by predators or squashed by vehicles. In Florida alone, artificial lights kill baby turtles in the thousands every year. They've wandered into active baseball games and, more horrifyingly, abandoned beach

fires. The caretaker of one property found hundreds of dead hatchlings piled beneath a single mercury-vapor lamp.

Artificial lights can also fatally attract insects and might be contributing to their alarming global declines. A single streetlamp can lure moths from 25 yards away, and a well-lit road might as well be a prison. Many of the insects that gather around streetlamps will likely be eaten or dead from exhaustion by sunrise. Those that zoom toward vehicle headlights probably won't last that long. The consequences of these losses can ripple across ecosystems and into the day. In 2014, as part of an experiment, ecologist Eva Knop installed streetlamps in seven Swiss meadows. After sunset, she then prowled these fields with night-vision goggles, peering into flowers to search for moths and other pollinators. By comparing these sites to others that had been kept dark, Knop showed that the illuminated flowers received 62 percent fewer visits from pollinating insects. One plant produced 13 percent less fruit even though it was also visited by a day shift of bees and butterflies.

It's not just the presence of light that matters but also its nature. Insects with aquatic larvae like mayflies and dragonflies will fruitlessly lay their eggs on wet roads, windows, and car roofs, because these reflect horizontally polarized light in the same way as bodies of water. Flickering lightbulbs can cause headaches and other neurological problems in humans, even though our eyes are usually too slow to detect these changes; what, then, would they do to animals with faster vision, like insects and small birds?

Colors matter, too. Red can disrupt migrating birds but is better for bats and insects.[*5] Yellow doesn't bother insects and turtles but can disrupt salamanders. No wavelength is perfect, Longcore says, but blue and white

are worst of all. Blue light disrupts body clocks and strongly attracts insects. It is also easily scattered, increasing the spread of light pollution. It is, however, cheap and efficient to produce. The new generation of energy-efficient white LEDs contain a lot of blue light, and, if the world switches to them from traditional yellow-orange sodium lights, the amount of global light pollution would increase by two or three times. “We can make better choices by tuning lights with intention,” Longcore says. “And we shouldn’t use full-spectrum at night. We shouldn’t want to give everything the signal that it’s constantly daytime.”

After talking to Longcore at his office in Los Angeles, I return home on a red-eye flight. As the plane takes off, I peer out the window at the illuminated city. The twinkling grid of lights still stirs the same primordial awe that comes from watching a starry sky or a moonlit sea. Humans equate light with knowledge. We draw lightbulbs to symbolize ideas, we describe intelligent people as bright sparks and luminaries, and we illuminated a path out of the Dark Ages. But as Los Angeles recedes beneath my window, that familiar awe is now tinged with unease. Light pollution is no longer just an urban problem, either. Light travels, metastasizing even into protected places that are otherwise untouched by human influence. The light from Los Angeles reaches Death Valley, the largest national park in the continental United States, 200 miles away. True darkness is increasingly hard to find.

So is true silence.

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IT'S A SUNNY April morning in Boulder, Colorado, and I've hiked up to a rocky hillside, about 6,000 feet above sea level. The world feels wider here, not just because of the panoramic view over conifer forests but also because it is blissfully quiet. Away from urban ruckus, quieter sounds are unmasked and become audible over greater distances. On the hillside, a chipmunk is rustling. Grasshoppers snap their wings together as they fly. A woodpecker pounds its beak against a nearby trunk. Wind rushes past. The longer I sit, the more I seem to hear.

Two men puncture the tranquility. I can't see them, but they're somewhere on the trail below, intent on broadcasting their opinions to all of Colorado. Further away, I can hear vehicles zooming along a highway beyond the trees. Denver hums in the distance, an ambient backdrop that I had all but blocked out. I notice a plane flying overhead, engines roaring. "I've been backpacking since the mid-sixties, and in that time, the number of aircraft has increased by a factor of six or seven," says Kurt Fristrup, whom I meet after my hike. "One of my favorite parlor tricks when friends visit is to ask, at the end of the hike, if they heard any aircraft. People will say they remember one or two. And I'll say there were twenty-three jets and two helicopters."

Fristrup works at the Natural Sounds and Night Skies Division of the National Park Service, a group that endeavors to safeguard (among other things) the United States' natural soundscapes. To protect them, the team first had to map them, and, unlike light, sound can't be detected by satellites. Fristrup and his colleagues spent years lugging recording equipment to almost 500 sites around the country, capturing nearly 1.5 million hours of audio. They found that human activity has doubled the

background noise levels in 63 percent of protected spaces, and increased them tenfold in 21 percent. In the latter places, “if you could have heard something 100 feet away, now you can only hear it 10 feet away,” Rachel Buxton of the NPS tells me. Aircraft and roads are the main culprits, but so are industries like oil and gas extraction, mining, and forestry. Even the most heavily protected areas are under acoustic siege.

In towns and cities, the problem is worse, and not just in the United States. Two-thirds of Europeans are immersed in ambient noise equivalent to perpetual rainfall. Such conditions are difficult for the many animals that communicate through calls and songs. In 2003, Hans Slabbekoorn and Margriet Peet found that noisy neighborhoods in Leiden, Netherlands, compel great tits to sing at higher frequencies, so their notes don’t get masked by the city’s low-pitched hubbub. A year later, Henrik Brumm found that the nightingales of Berlin, Germany, are forced to belt out their tunes more loudly to be heard over the urban din. These influential studies spurred a wave of research into noise pollution, which showed that urban and industrial noise can also change the timing of a bird chorus, suppress the complexity of their songs, and prevent them from finding mates. Even for city birds, noise hurts.

Noise pollution masks not only the sounds that animals deliberately make but also the “web of unintended sounds that ties communities together,” Fristrup tells me. He means the gentle rustles that tell owls where their prey are, or the faint flaps that warn mice about impending doom. “They are the most vulnerable parts of the soundscape to intrusion, and we’re cutting them off,” Fristrup says. Sound levels are measured in decibels, where a soft whisper is usually 30 decibels, normal

conversation is around 60, and a rock concert is about 110. Every extra 3 decibels can halve the range over which natural sounds can be heard. Noise shrinks an animal's perceptual world. And while some species like great tits and nightingales stay and make the best of it, others just leave.

In 2012, Jesse Barber, Heidi Ware, and Christopher McClure built a phantom road. On a ridge in Idaho that acts as a stopover for migrating birds, the team set up a half-mile corridor of speakers and played looped recordings of passing cars. At the sound of these disembodied noises, a third of the usual birds stayed away. Many of those that stayed paid a price for persisting. With tires and horns drowning out the sounds of predators, the birds spent more time looking for danger and less time looking for food. They put on less weight, and were weaker as they continued their arduous migrations. The phantom road experiment was pivotal in showing that wildlife could be deterred by noise and noise alone, detached from the sight of vehicles or the stench of exhaust. Hundreds of studies have come to similar conclusions.[*6] In noisy conditions, prairie dogs spend more time underground. Owls flub their attacks. Parasitic *Ormia* flies struggle to find their cricket hosts. Sage grouse abandon their breeding sites (and those that stay are more stressed).

Sounds can travel over long distances, at all times of day, and through solid obstacles. These qualities make them excellent stimuli for animals but also pollutants par excellence. The concept of pollution calls forth images of chemicals billowing from smokestacks, scum-covered rivers, and other visible signs of degradation. But noise can degrade habitats that look otherwise idyllic, and make otherwise livable places unlivable. It can act as an invisible

bulldozer that pushes animals out of their normal ranges.[*7] And where will they go? More than 83 percent of the continental United States lies within a kilometer of a road.

Even the seas can't offer silence. Although Jacques Cousteau once described the ocean as a silent world, it is anything but. It naturally teems with the sounds of breaking waves and blowing winds, bubbling hydrothermal vents and calving icebergs, all of which carry further and travel faster underwater than in air. Marine animals are noisy, too. Whales sing, toadfish hum, cod grunt, and bearded seals trill. Thousands of snapping shrimps, which stun passing fish with the shockwaves produced by their large claws, fill coral reefs with what sounds like sizzling bacon, or Rice Krispies popping in milk. Some of this soundscape has been muted as humans have netted, hooked, and harpooned the oceans' residents. Other natural noises have been drowned out by those that we added: the scrapes of nets that trawl the seafloor; the staccato beats of seismic charges used to scout for oil and gas; the pings of military sonar; and, as a ubiquitous backing track for all this hubbub, the sound of ships.[*8]

"Think about where your shoes come from," marine mammal expert John Hildebrand says as we talk in his office. I look; unsurprisingly, it's China. Some tanker carried those shoes across the Pacific, belching out a wake of sound that radiated for miles. Between World War II and 2008, the global shipping fleet more than tripled, and began moving 10 times more cargo at higher speeds. Together, they raised the levels of low-frequency noise in the oceans by 32 times—a 15-decibel increase over levels that Hildebrand suspects were already around 15 decibels louder than in primordial pre-propeller seas. Since giant whales can live for a century or more, there are likely

individuals alive today who have personally witnessed this growing underwater racket and who now only hear over a tenth of their former range. As ships pass in the night, humpback whales stop singing, orcas stop foraging, and right whales become stressed. Crabs stop feeding, cuttlefish change colors, damselfish are more easily caught. “If I said that I’m going to increase the noise level in your office by 30 decibels, OSHA would come in and say you’d need to wear earplugs,” Hildebrand tells me. “ We’re conducting an experiment on marine animals by exposing them to these high levels of noise, and it’s not an experiment we’d allow to be conducted on ourselves.”

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THE PREVIOUS 12 chapters of this book represent centuries of hard-won knowledge about the sensory worlds of other species. But in the time it took to accumulate that knowledge, we have radically remolded those worlds. We are closer than ever to understanding what it is like to be another animal, but we have made it harder than ever for other animals to be.

Senses that have served their owners well for millions of years are now liabilities. Smooth vertical surfaces, which don’t exist in nature, return echoes that sound like open air; perhaps that’s why bats so often crash into windows. DMS, the seaweed-y chemical that once reliably guided seabirds to food, now also guides them to the millions of tons of plastic waste that humans have dumped into the oceans; perhaps that’s why an estimated 90 percent of seabirds eventually swallow plastic. The currents produced by objects moving in the water can be detected by the body-wide hairs of manatees, but not with enough notice to

avoid a fast-moving speedboat; boat collisions are responsible for at least a quarter of deaths among Florida's manatees. Odorants in river water can guide salmon back to their streams of birth, but not if pesticides in that same water weaken their sense of smell. Weak electric fields at the bottom of the sea can guide sharks to buried prey, but also to high-voltage cables.

Some animals have come to tolerate the sights and sounds of modernity. Others even flourish among them. Some urban moths have evolved to become less attracted to light. Some urban spiders have gone in the opposite direction, spinning webs beneath streetlights to feast on the attracted insects. In the towns of Panama, nighttime lights drive frog-eating bats away, allowing male túngara frogs to add more sexy chucks to their songs without the risk of attracting predators. Animals can adapt, either by changing their behavior over an individual lifetime or by evolving new behaviors over many generations.

But adaptation is not always possible. Species with slow lives and long generations can't evolve quickly enough to keep pace with levels of light and noise pollution that double every few decades. Creatures that have already been confined to narrow corners of shrinking habitats can't just up and leave. Those that rely on specialized senses can't just retune their entire Umwelt. Coping with sensory pollution isn't a simple matter of habituation. "I don't think people quite understand that if you can't hear something, you don't suddenly become able to hear it," Clinton Francis tells me. "When your sensory organ *cannot perceive a signal,* you don't just get used to that."

Our influence is not inherently destructive, but it is often homogenizing. In pushing out sensitive species that cannot abide our sensory onslaughts, we leave behind smaller and

less diverse communities. We flatten the undulating sensescapes that have generated the wondrous variety of animal Umwelten. Consider Lake Victoria in East Africa. Once, it was home to over 500 species of cichlid fish, almost all of which were found nowhere else. That extraordinary diversity arose partly because of light. In deeper parts of the lake, light tends to be yellow or orange, while blue is more plentiful in shallower waters. These differences affected the eyes of the local cichlids and, in turn, their mating choices. Evolutionary biologist Ole Seehausen found that female cichlids from deeper waters prefer redder males, while those in the shallows have their eyes set on bluer ones. These diverging penchants acted like physical barriers, splitting the cichlids into a spectrum of differently colored forms. Diversity in light led to diversity in vision, in colors, and in species. But over the last century, runoff from farms, mines, and sewage filled the lake with nutrients that spurred the growth of clouding, choking algae. The old light gradients flattened in some places, the cichlids' colors and visual proclivities no longer mattered, and the number of species collapsed. By turning off the light in the lake, humans also switched off the sensory engine of diversity, leading to what Seehausen has called "the fastest large-scale extinction event ever observed."[*9]

A cynic might ask why it matters that a lake has fewer species of similar fish. Why get worked up about a woodland that has 21 species of birds instead of 32? In 2020, science writer Maya Kapoor pondered these questions in a story about the Yaqui catfish, an endangered species from the western United States that's similar to the extremely common channel catfish. "I wondered whether the loss of a species that looked just like one of the most

common fish species on the planet really mattered," Kapoor wrote. "Only later did it occur to me that…their seeming interchangeability said more about my limited understanding than it did about their limited distinctions." Her epiphany also applies to the cichlids, and to the many groups of animals where closely related members can have starkly different senses. As those species go extinct, so too do their Umwelten. With every creature that vanishes, we lose a way of making sense of the world. Our sensory bubbles shield us from the knowledge of those losses. But they don't protect us from the consequences.

In the woodlands of New Mexico, Clinton Francis and Catherine Ortega found that the Woodhouse's scrub-jay would flee from the noise of compressors used in extracting natural gas. The scrub-jay spreads the seeds of the pinyon pine tree, and a single bird can bury between 3,000 and 4,000 pine seeds a year. They are so important to the forests that in quiet areas where they still thrive, pine seedlings are four times more common than in noisy areas that they have abandoned. Pinyon pines are the foundation of the ecosystem around them—a single species that provides food and shelter for hundreds of others, including Indigenous Americans. To lose three-quarters of them would be disastrous. And since they grow slowly, "noise might have hundred-plus-year consequences for the entire ecosystem," Francis tells me.

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A BETTER UNDERSTANDING of the senses can show us how we're defiling the natural world. It can also point to ways of saving it. In 2016, marine biologist Tim Gordon traveled to Australia's Great Barrier Reef to begin his PhD work. He

should have spent months swimming among the corals' vivid splendor. Instead, "I watched in horror as my study site got completely obliterated," he tells me. A heat wave had forced the corals to expel the symbiotic algae that give them nutrients and colors. Without these partners, the corals starved and whitened in the worst bleaching event on record, and the first of several to come. Snorkeling through the rubble, Gordon found that the reefs had been not only bleached but also silenced. Snapping shrimps no longer snapped. Parrotfish no longer crunched. Those sounds normally help to guide baby fish back to the reef after their first vulnerable months out at sea. Soundless reefs were much less attractive. Gordon feared that if fish avoided the degraded reefs, the seaweed they normally eat would run amok, overgrowing the bleached corals and preventing them from rebounding. But in 2017, "we went back and thought: Can we flip that on its head?" he says.

He and his colleagues set up loudspeakers that continuously played recordings of healthy reefs over patches of coral rubble. The team would dive every few days to survey the local animals. "And on day 30," Gordon says, "I remember moseying around with my dive buddies and saying, 'There's a big pattern here, isn't there?' " After 40 days, he ran the numbers and saw that the acoustically enriched reefs had twice as many young fish as silent ones and 50 percent more species. They had not only been attracted by the sounds but stayed and formed a community. "It was a lovely experiment to do," Gordon says. It showed what conservationists can accomplish by "seeing the world through the perceptions of the animals you're trying to protect."[*10]

Realistically, this is a small-scale solution: Loudspeakers are expensive, and coral reefs are big. Without reducing

carbon emissions and forestalling climate change, reefs are in for a grim future, no matter how attractive they sound. Still, with half of the Great Barrier Reef already dead, corals need all the help they can get. Restoring their natural sounds might give them a fighting chance and make the task of saving them a little less Herculean.

Gordon's experiment was only possible because the team could still find healthy, unbleached reefs whose sounds they could record. Natural sensescapes still exist. There is still time to preserve and restore them before the last echo of the last reef fades into memory. In most cases, instead of adding stimuli that we have removed, we can simply remove those that we added—a luxury that doesn't apply to most pollutants. Radioactive waste can take millennia to degrade. Persistent chemicals like the pesticide DDT can thread their way through the bodies of animals long after they are banned. Plastics will continue to despoil the oceans for centuries even if all plastic production halts tomorrow. But light pollution ceases as soon as lights are turned off. Noise pollution abates once engines and propellers wind down. Sensory pollution is an ecological gimme—a rare example of a planetary problem that can be immediately and effectively addressed. And in the spring of 2020, the world did unknowingly address it.

As the COVID-19 pandemic spread, public spaces closed. Flights were grounded. Cars stayed parked. Cruise ships stayed docked. Around 4.5 billion people—almost three-fifths of the world's population—were told or encouraged to stay at home. As a result, many places became substantially darker and quieter. With fewer planes and cars on the move, the night skies around Berlin, Germany, were half as bright as normal. Seismic vibrations around the world were half as intense for months—the longest such reduction on

record. Alaska's Glacier Bay, a sanctuary for humpback whales, was half as loud as the previous year, as were cities in California, New York, Florida, and Texas.[*11] Sounds that would normally be muffled became clearer. City-dwellers around the world suddenly noticed singing birds. "People realized that there are all these animals around them that they hadn't sensed before," Francis tells me. "The sensory worlds of people in their backyards are huge compared to pre-COVID."[*12]

In a multitude of ways, the pandemic revealed the problems that societies had come to tolerate and the changes they were actually prepared to make. It showed that sensory pollution *can* be reduced if people are sufficiently motivated. Such reductions are possible without the debilitating consequences of a global lockdown. In the summer of 2007, Kurt Fristrup and his colleagues did a simple experiment at Muir Woods National Monument in California. On a random schedule, they stuck up signs that declared one of the most popular parts of the park a quiet zone and encouraged visitors to silence their phones and lower their voices. These simple steps, with no accompanying enforcement, reduced the noise levels in the park by 3 decibels, equivalent to 1,200 fewer visitors.

But personal responsibility cannot compensate for societal irresponsibility. To truly make a dent in sensory pollution, bigger steps are needed. Lights can be dimmed or switched off when buildings and streets are not in use. They can be shielded so that they stop shining above the horizon. LEDs can be changed from blue or white to red. Quiet pavements with porous surfaces can absorb the noise from passing vehicles. Sound-absorbing barriers, including berms on land and bubble nets in the water, can soften the din of traffic and industry. Vehicles can be diverted from

important areas of wilderness, or they can be forced to slow down: In 2007, when commercial ships in the Mediterranean began slowing down by just 12 percent, they produced half as much noise. Such vessels can also be fitted with quieter hulls and propellers, which are already used to muffle military ships (and would make commercial ones more fuel-efficient). Many helpful technologies already exist, but the economic incentives to make them cheaper or to deploy them en masse are lacking. We could regulate industries causing sensory pollution, but there's not enough societal will. "Plastic pollution in the sea looks hideous and everyone is worried, but noise pollution in the sea is something we don't experience, so no one's up in arms about it," Gordon tells me.

We normalize the abnormal, and accept the unacceptable. Remember that more than 80 percent of people live under light-polluted skies, and that two-thirds of Europeans are immersed in noise equivalent to constant rainfall. Many people have no idea what true darkness or quiet feels like. Within that inexperience, vicious cycles begin to spin. As we desecrate sensory environments, we become accustomed to the results. As we push animals away, we get used to their absence. As the problem of sensory pollution grows, our willingness to address it subsides. How do we solve a problem that we don't realize exists?

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IN 1995, ENVIRONMENTAL historian William Cronon wrote that "the time has come to rethink wilderness." In a searing essay, he argued that the concept of wilderness, especially as perceived in the United States, had become unjustly

synonymous with grandeur. Eighteenth-century thinkers believed that vast and magnificent landscapes reminded people of their own mortality and brought them closer to glimpsing the divine. “God was on the mountaintop, in the chasm, in the waterfall, in the thundercloud, in the rainbow, in the sunset,” Cronon wrote. “One has only to think of the sites that Americans chose for their first national parks—Yellowstone, Yosemite, Grand Canyon, Rainier, Zion—to realize that virtually all of them fit one or more of these categories. Less sublime landscapes simply did not appear worthy of such protection; not until the 1940s, for instance, would the first swamp be honored, in Everglades National Park, and to this day there is no national park in the grasslands.”

Equating wilderness with otherworldly magnificence treats it as something remote, accessible only to those with the privilege to travel and explore. It imagines that nature is something separate from humanity rather than something we exist within. “Idealizing a distant wilderness too often means not idealizing the environment in which we actually live, the landscape that for better or worse we call home,” Cronon wrote.

I couldn’t agree more. The majesty of nature is not restricted to canyons and mountains. It can be found in the wilds of perception—the sensory spaces that lie outside our Umwelt and within those of other animals. To perceive the world through other senses is to find splendor in familiarity, and the sacred in the mundane. Wonders exist in a backyard garden, where bees take the measure of a flower’s electric fields, leafhoppers send vibrational melodies through the stems of plants, and birds behold the hidden palettes of rurples and grurples. In writing this book, I have found the sublime while confined to my home

by a pandemic, watching tetrachromatic starlings gathering in the trees outside and playing sniffing games with my dog, Typo. Wilderness is not distant. We are continually immersed in it. It is there for us to imagine, to savor, and to protect.

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IN 1934, AFTER considering the senses of ticks, dogs, jackdaws, and wasps, Jakob von Uexküll wrote about the Umwelt of the astronomer. “Through gigantic optical aids,” he wrote, this unique creature has eyes that “are capable of penetrating outer space as far as the most distant stars. In its [Umwelt], suns and planets circle at a solemn pace.” The tools of astronomy can capture stimuli that no animal can naturally sense—X-rays, radio waves, and gravitational waves from colliding black holes. They extend the human Umwelt across the extent of the universe and back to its very beginning.

The tools of biologists are more modest in scale, but they too offer a glimpse into the infinite. Elizabeth Jakob used an eye tracker to watch the gaze of jumping spiders. Almut Kelber used night-vision goggles to watch elephant hawkmoths drinking from flowers in the dark. Paloma Gonzalez-Bellido used high-speed cameras to determine how fast killer flies see, and Ken Catania used them to work out how star-nosed moles hunt by touch. With lasers, Kurt Schwenk visualized the vortices that snakes make when they flick their tongues. With an ultrasound detector, Donald Griffin discovered the sonar of bats. Laser vibrometers and clip-on microphones allow Rex Cocroft to eavesdrop on leafhoppers. The Navy’s SOSUS hydrophones allowed Chris Clark to confirm how far blue whale calls can

travel. With simple electrodes, Eric Fortune and other electric fish researchers can listen in on the pulses of knifefish and elephantfish. With microscopes, cameras, speakers, satellites, recorders, and even paper-lined cages with inkpads at their bases, people have explored other sensory worlds. We have used technology to make the invisible visible and the inaudible audible.

This ability to dip into other Umwelten is our greatest sensory skill. Think back to the hypothetical room that we envisioned at the start of this book, with the elephant, the rattlesnake, and all the rest. Among that imaginary menagerie, the human—Rebecca—lacked ultraviolet vision, magnetoreception, echolocation, and an infrared sense. But she was the only creature capable of knowing what the others were sensing and, perhaps, the only one who might care.

A bogong moth will never know what a zebra finch hears in its song, a zebra finch will never feel the electric buzz of a black ghost knifefish, a knifefish will never see through the eyes of a mantis shrimp, a mantis shrimp will never smell the way a dog can, and a dog will never understand what it is like to be a bat. We will never fully do any of these things either, but we are the only animal that can even come close. We may not ever know what it is to be an octopus, but at least we know that octopuses exist, and that their experiences differ from ours. Through patient observation, through the technologies at our disposal, through the scientific method, and, above all else, through our curiosity and imagination, we can try to step into their worlds. We must choose to do so, and to have that choice is a gift. It is not a blessing we have earned, but it is one we must cherish.

SKIP NOTES

*1 A team of Dutch scientists led by Kamiel Spoelstra discovered this pattern in 2017. In response, a neighborhood within the town of Nieuwkoop, which sits next to a nature reserve, switched its streetlights to bat-friendly red LEDs.

*2 As we've seen, migrating birds use a variety of senses to guide their way. Collisions with communication towers seem to happen when all of their senses are befuddled at once—when bad weather prevents them from seeing visual landmarks, and when red lights disable their compasses.

*3 Scientific studies on light pollution tend to use the acronym *ALAN* to refer to artificial light at night. Unfortunately, this means that a lot of papers read like they are passive-aggressively shouting at some guy called Alan, who is single-handedly screwing things up for wildlife. "ALAN may affect a diverse array of nocturnally active animals," says one. "The biological impact of even low intensities of ALAN may be marked," claims another.

*4 There had been earlier accounts of birds crashing into lit buildings and turtle hatchlings heading toward lit cities. But Longcore says that an international conference in 2002 marked a moment when a smattering of concerned researchers started becoming a coherent field.

*5 The red lights that Barber used in the Grand Tetons shouldn't be a problem because they're not high enough to waylay migrating birds.

*6 In one experiment, ladybird beetles ate fewer aphids when exposed to either urban sounds or the music of AC/DC, disproving the band's hypothesis that "rock and roll ain't noise pollution."

*7 In the summer of 2017, ecologist Justin Suraci did a version of Barber's experiment by playing the sound of human speech through speakers set up in the Santa Cruz Mountains. Whether it was Suraci reading poetry or Rush Limbaugh spewing bile, mountain lions, bobcats, and other predators moved away when they heard the voices. This isn't an issue of noise pollution in the classic sense, though. It's more that humans are terrifying superpredators, whose very voices are enough to unnerve other hunters.

*8 Beaked whales have repeatedly stranded en masse after exposure to naval sonar, prompting waves of research and litigation. *War of the Whales* by Joshua Horwitz offers a masterly account of the events that connected naval sonar to whale strandings, and the legal battles that ensued. "Indisputably,

you can use sonar and get a beaked whale to strand," John Hildebrand tells me. "Why they do that is still a mystery." It's unclear if the sound physically injures them or causes them to swim erratically and get the bends. Either way, sonar clearly disturbs them.

*9 Lake Victoria's cichlids also suffered because of overfishing and exploding numbers of the invasive Nile perch. But even when the perch declined and cichlid numbers bounced back, the diversity of cichlid species remained much lower in cloudy waters. Note that light conditions are just one of several factors that explained the incredible diversity of Lake Victoria's cichlids.

*10 Conversely, conservation attempts can backfire if they fail to account for different Umwelten. Wire cages that are sometimes put up to protect turtle nests from raccoons and foxes could distort the magnetic fields around those nests and disrupt the hatchlings' ability to learn the magnetic signatures of their home beaches.

*11 Behavioral ecologist Elizabeth Derryberry found that the songs of white-crowned sparrows in the Bay Area were a third quieter during the lockdown of spring 2020, when they had less urban noise to contend with.

*12 Similar reductions in noise pollution followed other recent disasters. Oceanic noise fell in the waters off California after the financial collapse of 2008, and in the Bay of Fundy, Canada, after the September 11 terrorist attacks of 2001. The latter change seemed to reduce stress among right whales.

The side-facing slits of a dog’s nostrils allow its exhalations to waft more odors into its nose.

Clonal raider ants have been marked with paint so they can be easily tracked.

Organs of smell come in varied forms, including the trunks of elephants, the beaks of albatrosses, and the forked tongues of snakes.

With receptors on their feet, butterflies and other insects can taste things by landing on them.

Catfish are swimming tongues, with taste buds dotted all over their skins.

A jumping spider’s central eyes offer sharp vision, while the pair on the side tracks movements.

The killer fly’s ultrafast vision allows it to capture quick-flying insects in the span of a human blink.

The bay scallop has dozens of bright blue eyes along the rim of its shell.

The brittle star’s entire body is an eye, but only during the daytime.

The huge top part of a male mayfly’s eye allows it to spot passing females.

A chameleon can look forward and behind simultaneously with its independent eyes.

With two eyes fused into a single cylinder, Streetsia challengeri *can see above, below, and to the sides, but not in front.*

In darkness so intense that you couldn’t see your own hand, this nocturnal sweat bee can still spot its small jungle nest.

The elephant hawkmoth can see the colors of flowers, even under dim starlight.

Typo the corgi, a very good boy, is modeling the difference between the trichromatic color vision of (most) humans and the dichromatic vision of dogs.

Many natural patterns, including the markings on flowers and the facial stripes of the ambon damselfish, are visible only to eyes that can see ultraviolet.

The bib of the broad-tailed hummingbird and the wing bars of the Heliconius erato *butterflies reflect ultraviolet colors that humans can’t perceive.*

The peacock mantis shrimp sees color in a completely different way than other animals do, using the midband of its three-part eyes.

The naked mole-rat is insensitive to the pain of acids and capsaicin, the chemical that gives chilies their kick.

The thirteen-lined ground squirrel can hibernate through the winter because it is insensitive to cold temperatures that we'd find painful.

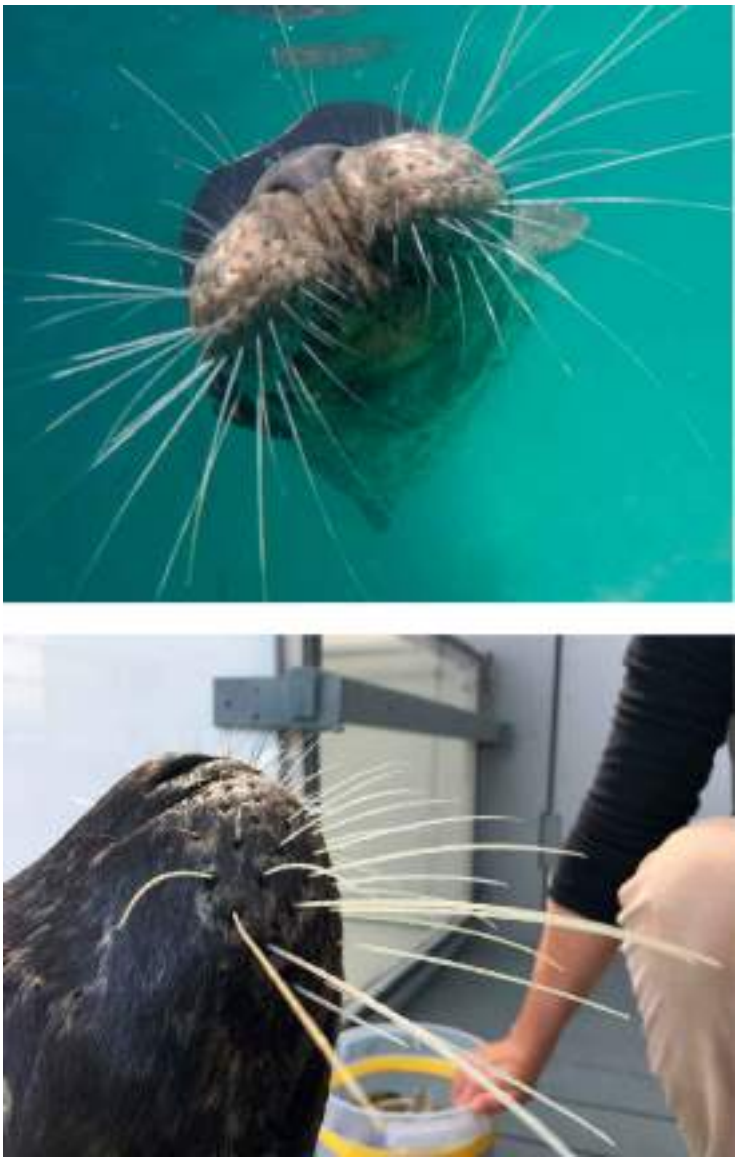
These animals can all sense the infrared radiation emanating from warm objects. Fire-chaser beetles do so to find burning forests, while vampire bats and rattlesnakes track down warm-blooded prey.

Sea otters use their sensitive paws to quickly feel for prey they can’t see, while red knots do the same by probing into sand with their bills.

Tactile organs come in many forms—the nose of the star-nosed mole, the sting of the emerald jewel wasp, the facial feathers of the crested auklet, and the whiskers of a mouse.

Manatees manipulate objects and greet each other with their exquisitely touch-sensitive lips.

The bumps on a crocodile’s snout can detect gentle ripples made by its prey.



Even while blindfolded, Sprouts the harbor seal can track fish by using his whiskers to follow the invisible trails they leave in the water.

Courting peacocks create airflow patterns that they can sense with their crest feathers.

With their sensitive hairs, tiger wandering spiders can detect the air currents created by passing flies.

Treehoppers communicate by sending vibrations through the plants on which they stand. When converted into sound, these normally inaudible songs can resemble those of birds, monkeys, or musical instruments.

Sand scorpions sense the footfalls of their prey. Golden moles detect the thrums of wind blowing over termite-rich sand dunes. Treefrog tadpoles hatch when they feel the vibrations of chewing snakes.

The Nephila *spider's orb web is an extension of its own sensory system and mind—but the small* Argyrodes *spider can hack into it.*

These masters of hearing excel at pinpointing the locations of sound. The barn owl listens for scuttling rodents, while the parasitic Ormia *fly listens out for courting crickets.*

The call of the male túngara frog was shaped by the sensory bias of the female frog’s ear.

Zebra finches listen for fast details that humans cannot perceive in their songs.

Blue whales and Asian elephants can communicate over long distances with low-pitched infrasonic calls. In quieter eras, the whales' calls could carry across entire oceans.

The Philippine tarsier communicates in ultrasonic frequencies that are inaudible to us.

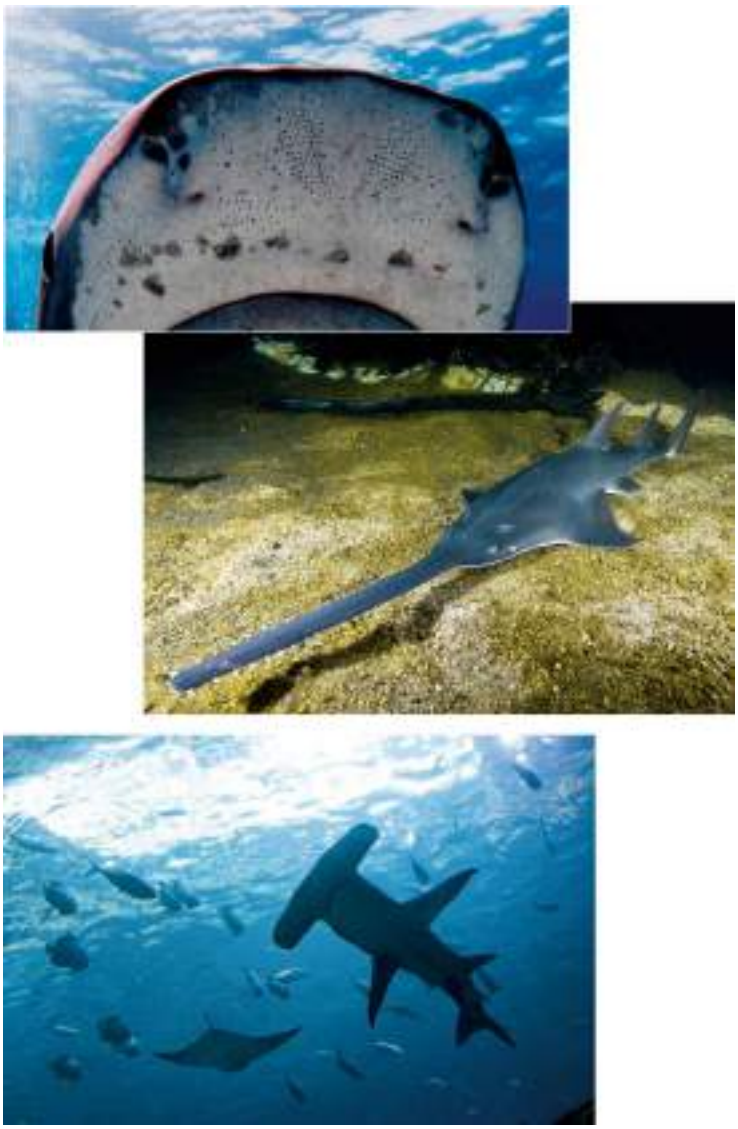
The greater wax moth hears higher frequencies than any other known animal.

Strangely, the blue-throated hummingbird sings ultrasonic notes that it cannot hear.

A big brown bat attacks a luna moth. The colored spectrogram represents echolocation: As the bat closes in, its calls become faster and shorter, providing it with crisper detail.

Dolphins can use their sonar to find buried objects, coordinate formations, and distinguish fish by the shape of their air-filled gas bladders.

The black ghost knifefish, the electric eel, the glass knifefish, and the Ubangi elephantfish all produce their own electric fields, which they use to sense the world around them.



Tiny pores called ampullae of Lorenzini allow sharks and rays to detect the minute electric fields produced by their prey. These ampullae are especially common on the heads of sawfish and hammerhead sharks.

The platypus’s bill can sense both pressure and electric fields, which it might combine into a single sense of electrotouch.

Bumblebees can sense the electric fields of flowers.

Bogong moths, European robins, and loggerhead turtles can all navigate over long distances by sensing Earth’s magnetic field.

An octopus’s arms are partly independent; they can sense and explore the world without direction from the central brain.

For Liz Neeley, who sees me

Acknowledgments

At the end of 2018, I was sitting in a London café with my wife, Liz Neeley, telling her that while I very much wanted to write a second book, my well of ideas had run dry. Liz listened patiently, and then gently suggested that I could write about how animals perceive the world. This kind of thing happens a lot.

The idea drew from our shared interest in nature. It flowed naturally from our entire careers: Liz had started her marine biology PhD on the visual systems of coral reef fish, and I had written about sensory biology for over a decade. It reflected our desire to tell the stories of those whose lives often go overlooked or unheard. I'm profoundly grateful to Liz not just for seeding the idea of this book and supporting me through its creation, but for embodying its values and instilling them in me. She is relentlessly joyful, curious, and empathetic, and she brings those same qualities out in people who have the privilege to know her. To spend time with Liz is to see the world and its inhabitants in new ways—exactly the feeling that I hope you, dear reader, got from the preceding pages.

For shepherding this book from concept to finished product, my deepest thanks go to: Will Francis, my British agent and friend, who saw the promise in this idea from the start and helped to nurture it into life; PJ Mark, my American agent; Hilary Redmon, my American publisher and intellectual co-conspirator, who edited the early drafts into shape; and Stuart Williams, my British publisher, who

also provided incisive notes on the manuscript. All four of them were also involved in my first book, *I Contain Multitudes,* and getting to work with them again was like coming home.

Sarah Laskow and Ross Andersen, my editors at *The Atlantic,* deserve huge credit for everything they've taught me about writing over the last years; they didn't directly work on this book, but their influence in these pages runs deep. They, together with Robert Brenner, Meehan Crist, Tom Cunliffe, Rose Eveleth, Natalie Omundsen, Sarah Ramey, Rebecca Skloot, Beck Smith, Maddie Sofia, and Maryam Zaringhalam, also kept me afloat in a very difficult year, when I turned my attention from the delightful realms of animal senses to the more grueling and tragic world of the COVID-19 pandemic.

I spoke to more scientists in the course of writing this book than I could reasonably list, many of whom were incredibly generous with their time. My deepest thanks to Jesse Barber, Bruce Carlson, Rex Cocroft, Robyn Crook, Heather Eisthen, Ken Lohmann, Colleen Reichmuth, Cassie Stoddard, and Eric Warrant for crucial feedback on various chapters and deep discussions. Thanks also to most of the above, and to Whitlow Au, Gordon Bauer, Adriana Briscoe, Astra Bryant, Rulon Clark, Tom Cronin, Molly Cummings, Elena Gracheva, Frank Grasso, Alexandra Horowitz, Martin How, Elizabeth Jakob, Sonke Johnsen, Suzanne Amador Kane, Daniel Kish, Daniel Kronauer, Travis Longcore, Malcolm MacIver, Justin Marshall, Beth Mortimer, Cindy Moss, Paul Nachtigall, Dan-Eric Nilsson, Thomas Park, Daniel Robert, Nicholas Roberts, Mike Ryan, Nate Sawtell, Kurt Schwenk, Jim Simmons, Daphne Soares, Amy Streets, Leslie Vosshall, Karen Warkentin, and George Wittemyer for variously showing me their labs, their animals, or their

lives. Special thanks to Matthew Cobb for early encouragement and a very useful set of slides, Catherine Williams for helping me think through the chapter on pain in the early stages, Michael Hendricks for his help in shaping the chapter on unifying the senses, Eleanor Caves for creating a bespoke figure based on her acuity work; and Brian Branstetter, Ken Catania, Kurt Fristrup, Amanda Melin, Nate Morehouse, and Aude Pacini for especially helpful discussions.

I’m also profoundly grateful to Ashley Shew, a brilliant thinker on the intersection between technology and disability, for giving the manuscript a thorough sensitivity read, and helping me to avoid the insidiously ableist language and ideas that characterize so much writing about the senses. (Any lingering errors in the text are mine and mine alone.)

It was a pleasure to meet Finn the dog, Margaret the rattlesnake, Sprouts the harbor seal, Hugh and Buffett the manatees, Zipper the big brown bat, Blubby the electric catfish, Qualia and Ra the octopuses, and the unnamed mantis shrimp who punched me in the finger. And finally, thanks to Moro, Ellers, Athena, Ruby, Midge, Ezra, Bingo, Nellie, Bennet, Margaux, Canela, Dolly, Tim, Janet, Clarence, Zako, Whiskey, Caleb, Posey, Tesla, Crosby, Bing, Bear, Buddy, Mickey, and especially to my dearest Typo for teaching me to have animals in my heart and home as well as in my head. To all the other very good dogs (and cats) whom I’m sure I have forgotten, I am so sorry. It’s a good thing you can’t read.

Notes

INTRODUCTION

It was defined and popularized: (Uexküll, 1909)

GO TO NOTE REFERENCE IN TEXT

Uexküll compared an animal's body: A modern translation of Uexküll's seminal work is Uexküll (2010).

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"Each house has a number of windows": (Uexküll, 2010, p. 200)

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"They move finished and complete": (Beston, 2003, p. 25)

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To sense the world: A classic work on the basics of sensory biology is Dusenbery (1992).

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The neuroscientist Malcolm MacIver thinks: (Mugan and MacIver, 2019)

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Animals have to keep the neurons: (Niven and Laughlin, 2008; Moran, Softley, and Warrant, 2015) GO TO NOTE REFERENCE IN TEXT
In 1987, German scientist Rüdiger Wehner: (Wehner, 1987)

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"constricted and transformed": (Uexküll, 2010, p. 51)

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Giant whales have: (Pyenson et al., 2012)

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Inspired by that conversation: (Johnsen, 2017)

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But according to the philosopher Fiona Macpherson: (Macpherson, 2011)

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“senses cannot be clearly divided”: (Macpherson, 2011, p. 36)

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“there is no reason to suppose”: (Nagel, 1974, pp. 438–439)

GO TO NOTE REFERENCE IN TEXT

Zoologist Donald Griffin: (Griffin, 1974)

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“an informed imaginative leap”: (Horowitz, 2010, p. 243)

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“The only true voyage”: (Proust, 1993, p. 343)

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CHAPTER 1

Horowitz is an expert: For more on dogs and their sense of smell, I highly recommend two books by Alexandra Horowitz (2010, 2016).

GO TO NOTE REFERENCE IN TEXT

Those faces are now easier: (Kaminski et al., 2019)

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But when a dog sniffs: (Craven, Paterson, and Settles, 2010)

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Humans share the same basic: (Quignon et al., 2012)

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The shape of their nostrils: (Craven, Paterson, and Settles, 2010)

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In one experiment: (Steen et al., 1996)

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Scientists have tried to find: (Krestel et al., 1984; Walker et al., 2006; Wackermannová, Pinc, and Jebavý, 2016) GO TO NOTE REFERENCE IN TEXT
In one study, two dogs: (Krestel et al., 1984)

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In past experiments: (Hepper, 1988)

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They could detect a single fingerprint: (Hepper and Wells, 2005)

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They could work out which direction: (King, Becker, and Markee, 1964)

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Depending on the species, stressed frogs: (Smith et al., 2004)

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One possible exception is the puff adder: (Miller, Maritz, et al., 2015)

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When Horowitz tallied every study: (Horowitz and Franks, 2020)

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In front of each animal: (Duranton and Horowitz, 2019)

GO TO NOTE REFERENCE IN TEXT

Some dislike that dogs get treated: (Pihlström et al., 2005)

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In some cases, humans do *better:* (Laska, 2017) GO TO NOTE REFERENCE IN TEXT

McGann traced the origin: (McGann, 2017)

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In 2019, Tali Weiss identified: (Weiss et al., 2020)

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“of extremely slight service”: (Darwin, 1871, volume 1, p. 24)

GO TO NOTE REFERENCE IN TEXT

“smell does not allow itself”: (Kant, 2007, p. 270)

GO TO NOTE REFERENCE IN TEXT

The English language confirms his view: (Majid, 2015)

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“is the one without words”: (Ackerman, 1991, p. 6)

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The Jahai people of Malaysia: (Majid et al., 2017; Majid and Kruspe, 2018)

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In 2006, neuroscientist Jess Porter: (Porter et al., 2007)

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Their signals can then be detected: (Silpe and Bassler, 2019)

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Chemicals, then, are the most ancient: (Dusenbery, 1992)

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The variation among possible odorants: An excellent review on the basics of olfaction is Keller and Vosshall (2004b).

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When mixed, some pairs of odors: (Keller and Vosshall, 2004b)

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Noam Sobel, a neurobiologist: (Ravia et al., 2020)

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Their noses are kings of infinite space: Reviews on smell: Eisthen (2002); Ache and Young (2005); Bargmann (2006).

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In work that would earn them a Nobel: (Firestein, 2005)

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One widely popularized theory: (Keller and Vosshall, 2004a)

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For example, the OR7D4 gene: (Keller et al., 2007)

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Male moths, for example: (Vogt and Riddiford, 1981)

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Smell is so important to them: (Kalberer, Reisenman, and Hildebrand, 2010)

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Moths have been described as: (Atema, 2018)

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By mimicking female moth odors: (Haynes et al., 2002)

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The chemicals they use are pheromones: A review on animal pheromones is Wyatt (2015a).

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Indeed, despite the existence of pheromone parties: (Wyatt, 2015b)

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Human pheromones likely exist: (Wyatt, 2015b)

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Ant pheromones are another story: (Leonhardt et al., 2016)

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Leafcutter ants are so sensitive: (Tumlinson et al., 1971)

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Known as cuticular hydrocarbons: (Sharma et al., 2015)

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Queens also use these substances: (Monnin et al., 2002)

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Red ants will look after: (Lenoir et al., 2001)

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Army ants are so committed: (Schneirla, 1944)

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In September 2020, I noted: (Yong, 2020)

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Many ants use pheromones to discern dead: (Wilson, Durlach, and Roth, 1958)

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“The ant world is a tumult”: (Treisman, 2010)

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Ant civilizations are among the most impressive: (D’Ettorre, 2016)

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Ants are essentially a group of: (Moreau et al., 2006)

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Along the way, their repertoire of odorant receptor genes: (McKenzie and Kronauer, 2018) GO TO NOTE REFERENCE IN TEXT
Why? Here are three clues: (McKenzie and Kronauer, 2018)

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When Kronauer deprived his clonal raiders: (Trible et al., 2017)

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Back in 1874, the Swiss scientist: (Forel, 1874)

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Female lobsters urinate into the faces: (Atema, 2018)

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Male mice produce a pheromone: (Roberts et al., 2010)

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The early spider-orchid deceives male bees: (Schiestl et al., 2000)

GO TO NOTE REFERENCE IN TEXT

“We live, all the time”: (Wilson, 2015)

GO TO NOTE REFERENCE IN TEXT

You don’t need to know about an elephant’s: (Niimura, Matsui, and Touhara, 2014)

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African elephants can use their trunks: (McArthur et al., 2019)

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They can learn unfamiliar smells: (Miller, Hensman, et al., 2015)

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Two of those same elephants: (von Dürckheim et al., 2018)

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Asian elephants are no slouches, either: (Plotnik et al., 2019)

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When the animals approached washed garments: (Bates et al., 2007)

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When African elephants reunite: (Moss, 2000)

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Few people have done more to study elephant odors: (Hurst et al., 2008)

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In 1996, after 15 years of work: (Rasmussen et al., 1996)

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Rasmussen eventually discovered that elephants: (Rasmussen and Schulte, 1998)

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As they walk the time-worn trails: (Hurst et al., 2008)

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In 2007, Lucy Bates found: (Bates et al., 2008)

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Elephants that have returned to postwar Angola: (Miller, Hensman, et al., 2015)

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They’ve been known to dig wells: (Ramey et al., 2013)

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Rasmussen once speculated: (Rasmussen and Krishnamurthy, 2000)

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Salmon can return: (Wisby and Hasler, 1954)

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Whip spiders use the smell sensors: (Bingman et al., 2017)

GO TO NOTE REFERENCE IN TEXT

Polar bears might: (Owen et al., 2015)

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These examples are so common: (Jacobs, 2012)

GO TO NOTE REFERENCE IN TEXT

John James Audubon, the avid naturalist: (Stager, 1964; Birkhead, 2013; Eaton, 2014)

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These birds, he claimed in 1826: (Audubon, 1826)

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Ornithologist Kenneth Stager: (Stager, 1964)

GO TO NOTE REFERENCE IN TEXT

Betsy Bang revitalized it: A historical look at Bang and Wenzel's influence is Nevitt and Hagelin (2009).

GO TO NOTE REFERENCE IN TEXT

Concerned that the textbooks were spouting misinformation: (Bang, 1960; Bang and Cobb, 1968) GO TO NOTE REFERENCE IN TEXT
For them, "olfaction is of primary importance": (Nevitt and Hagelin, 2009)

GO TO NOTE REFERENCE IN TEXT

By scanning the skulls: (Zelenitsky, Therrien, and Kobayashi, 2009)

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Elsewhere in California, Bernice Wenzel: (Sieck and Wenzel, 1969)

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She repeated that test: (Wenzel and Sieck, 1972)

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Both Bang and Wenzel: (Nevitt and Hagelin, 2009)

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In the varying levels of the chemical: (Nevitt, 2000)

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Once back on her feet, Nevitt: (Nevitt, Veit, and Kareiva, 1995)

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She calculated that they can detect: (Nevitt and Bonadonna, 2005)

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She showed that some tubenoses: (Bonadonna et al., 2006; Van Buskirk and Nevitt, 2008) GO TO NOTE REFERENCE IN TEXT
Henri Weimerskirch fitted wandering albatrosses: (Nevitt, Losekoot, and Weimerskirch, 2008) GO TO NOTE REFERENCE IN TEXT
The smellscapes that seabirds track: (Nevitt, 2008; Nevitt, Losekoot, and Weimerskirch, 2008) GO TO NOTE REFERENCE IN TEXT
She transported a few Cory's shearwaters: (Gagliardo et al., 2013)

GO TO NOTE REFERENCE IN TEXT

"What may be featureless to us": (Nicolson, 2018, p. 230)

GO TO NOTE REFERENCE IN TEXT

By comparing the odorants: (Sobel et al., 1999)

GO TO NOTE REFERENCE IN TEXT

Whatever the case, serious scholars: (Schwenk, 1994)

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Using its tongue, a male garter snake: (Shine et al., 2003)

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By comparing what she deposited: (Ford and Low, 1984)

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Schwenk reasoned that the fork: (Schwenk, 1994)

GO TO NOTE REFERENCE IN TEXT

Rulon Clark, whom we'll meet: (Clark, 2004; Clark and Ramirez, 2011)

GO TO NOTE REFERENCE IN TEXT

Aside from lethal toxins: (Durso, 2013)

GO TO NOTE REFERENCE IN TEXT

The snakes can use these aromas: (Chiszar et al., 1983, 1999; Chiszar, Walters, and Smith, 2008) GO TO NOTE REFERENCE IN TEXT
Chuck Smith, one of Schwenk's former students: (Smith et al., 2009)

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Bill Ryerson, another of Schwenk's students: (Ryerson, 2014)

GO TO NOTE REFERENCE IN TEXT

For some reason, humans lost our vomeronasal: (Baxi, Dorries, and Eisthen, 2006)

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Without it, garter snakes stop following: (Kardong and Berkhoudt, 1999)

GO TO NOTE REFERENCE IN TEXT

In other animals, the organ is a mystery: (Baxi, Dorries, and Eisthen, 2006)

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Adults vary so much: (Pain, 2001)

GO TO NOTE REFERENCE IN TEXT

And while smell can be put: (Yarmolinsky, Zuker, and Ryba, 2009)

GO TO NOTE REFERENCE IN TEXT

When a python swallows a pig: (Secor, 2008)

GO TO NOTE REFERENCE IN TEXT

Bees can detect the sweetness: (de Brito Sanchez et al., 2014)

GO TO NOTE REFERENCE IN TEXT

Flies can taste the apple: (Thoma et al., 2016)

GO TO NOTE REFERENCE IN TEXT

Parasitic wasps can use taste sensors: (Van Lenteren et al., 2007)

GO TO NOTE REFERENCE IN TEXT

But if that arm is covered with bitter-tasting DEET: (Dennis, Goldman, and Vosshall, 2019) GO TO NOTE REFERENCE IN TEXT
Some have taste receptors on their wings: (Raad et al., 2016)

GO TO NOTE REFERENCE IN TEXT

Flies will start grooming themselves: (Yanagawa, Guigue, and Marion-Poll, 2014)

GO TO NOTE REFERENCE IN TEXT

The most extensive sense of taste: (Atema, 1971; Caprio et al., 1993)

GO TO NOTE REFERENCE IN TEXT

They have taste buds: (Kasumyan, 2019)

GO TO NOTE REFERENCE IN TEXT

They're exquisitely sensitive to amino acids: (Caprio, 1975)

GO TO NOTE REFERENCE IN TEXT

So in the mid-1990s: (Caprio et al., 1993)

GO TO NOTE REFERENCE IN TEXT

Cats, spotted hyenas: (Jiang et al., 2012)

GO TO NOTE REFERENCE IN TEXT

Vampire bats, which drink only blood: (Shan et al., 2018)

GO TO NOTE REFERENCE IN TEXT

Other leaf-eating specialists, like koalas: (Johnson et al., 2018)

GO TO NOTE REFERENCE IN TEXT

In 2014, evolutionary biologist Maude Baldwin: (Toda et al., 2021)

GO TO NOTE REFERENCE IN TEXT

Baldwin also showed that hummingbirds: (Baldwin et al., 2014)

GO TO NOTE REFERENCE IN TEXT

This is how all animals see: (Nilsson, 2009)

GO TO NOTE REFERENCE IN TEXT

CHAPTER 2

The *Portia* species are famed: (Cross et al., 2020) GO TO NOTE REFERENCE IN TEXT
And unlike other spiders: (Morehouse, 2020)

GO TO NOTE REFERENCE IN TEXT

The late British neurobiologist Mike Land: Land wrote great accounts of his own work in Land (2018).

GO TO NOTE REFERENCE IN TEXT

In 1968, he developed an ophthalmoscope: (Land, 1969a, 1969b)

GO TO NOTE REFERENCE IN TEXT

“an exhilarating but very weird”: (Land, 2018, p. 107)

GO TO NOTE REFERENCE IN TEXT

And here’s the truly bizarre part: (Jakob et al., 2018)

GO TO NOTE REFERENCE IN TEXT

The eyes of the giant squid: (Nilsson et al., 2012; Polilov, 2012)

GO TO NOTE REFERENCE IN TEXT

Squid, jumping spiders, and humans: A review of animal eyes is Nilsson (2009).

GO TO NOTE REFERENCE IN TEXT

Animal eyes can be bifocal: (Stowasser et al., 2010; Thomas, Robison, and Johnsen, 2017)

GO TO NOTE REFERENCE IN TEXT

They can have lenses: (Li et al., 2015)

GO TO NOTE REFERENCE IN TEXT

Jakob’s colleague Nate Morehouse: (Goté et al., 2019)

GO TO NOTE REFERENCE IN TEXT

vision “is about light”: (Johnsen, 2012, p. 2)

GO TO NOTE REFERENCE IN TEXT

Every animal that sees does: (Porter et al., 2012)

GO TO NOTE REFERENCE IN TEXT

In 2012, evolutionary biologist Megan Porter: (Porter et al., 2012)

GO TO NOTE REFERENCE IN TEXT

Vision is diverse: The textbook *Visual Ecology* is a fantastic and very readable primer on vision and its many uses (Cronin et al., 2014).

GO TO NOTE REFERENCE IN TEXT

The biologist Dan-Eric Nilsson: (Nilsson, 2009)

GO TO NOTE REFERENCE IN TEXT

The hydra, a relative of jellyfish: (Plachetzki, Fong, and Oakley, 2012)

GO TO NOTE REFERENCE IN TEXT

Olive sea snakes have photoreceptors: (Crowe-Riddell, Simões, et al., 2019)

GO TO NOTE REFERENCE IN TEXT

Octopuses, cuttlefish, and other cephalopods: (Kingston et al., 2015)

GO TO NOTE REFERENCE IN TEXT

The Japanese yellow swallowtail butterfly: (Arikawa, 2001)

GO TO NOTE REFERENCE IN TEXT

This flurry of evolutionary innovation: (Parker, 2004)

GO TO NOTE REFERENCE IN TEXT

“To suppose that the eye”: (Darwin, 1958, p. 171)

GO TO NOTE REFERENCE IN TEXT

The jellyfish alone have evolved: (Picciani et al., 2018)

GO TO NOTE REFERENCE IN TEXT

In 1994, Nilsson and Susanne Pelger: (Nilsson and Pelger, 1994)

GO TO NOTE REFERENCE IN TEXT

As we saw in the introduction: (Garm and Nilsson, 2014)

GO TO NOTE REFERENCE IN TEXT

Consider the freshwater bacterium *Synechocystis:* (Schuergers et al., 2016) GO TO NOTE REFERENCE IN TEXT

The warnowiids, a group of single-celled algae: (Gavelis et al., 2015)

GO TO NOTE REFERENCE IN TEXT

Caro had become the latest: (Caro, 2016)

GO TO NOTE REFERENCE IN TEXT

She and Caro calculated that: (Melin et al., 2016)

GO TO NOTE REFERENCE IN TEXT

Caro has a definitive answer: to ward off bloodsucking flies: (Caro et al., 2019)

GO TO NOTE REFERENCE IN TEXT

An animal's visual acuity: An excellent review of visual acuity in animals is Caves, Brandley, and Johnsen (2018).

GO TO NOTE REFERENCE IN TEXT

The current record, at 138 cycles per degree: (Reymond, 1985; Mitkus et al., 2018) GO TO NOTE REFERENCE IN TEXT

One oft-quoted study from the 1970s: (Fox, Lehmkuhle, and Westendorf, 1976)

GO TO NOTE REFERENCE IN TEXT

Sensory biologist Eleanor Caves: (Caves, Brandley, and Johnsen, 2018)

GO TO NOTE REFERENCE IN TEXT

Octopuses (46 cpd): (Veilleux and Kirk, 2014; Caves, Brandley, and Johnsen, 2018)

GO TO NOTE REFERENCE IN TEXT

Robber flies manage: (Feller et al., 2021)

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For a fly's eye: (Kirschfeld, 1976)

GO TO NOTE REFERENCE IN TEXT

Each half of a scallop's: (Mitkus et al., 2018)

GO TO NOTE REFERENCE IN TEXT

It's even stranger that those eyes: (Land, 1966)

GO TO NOTE REFERENCE IN TEXT

And both are found in the scallop: (Speiser and Johnsen, 2008a)

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He strapped their shells: (Speiser and Johnsen, 2008b)

GO TO NOTE REFERENCE IN TEXT

In 1964, Mike Land: (Land, 2018)

GO TO NOTE REFERENCE IN TEXT

Guanine crystals don't naturally form squares: (Palmer et al., 2017)

GO TO NOTE REFERENCE IN TEXT

Chitons are mollusks: (Li et al., 2015)

GO TO NOTE REFERENCE IN TEXT

Fan worms look like: (Bok, Capa, and Nilsson, 2016)

GO TO NOTE REFERENCE IN TEXT

Giant clams look like: (Land, 2003)

GO TO NOTE REFERENCE IN TEXT

In 2018, Lauren Sumner-Rooney: (Sumner-Rooney et al., 2018)

GO TO NOTE REFERENCE IN TEXT

Like brittle stars, sea urchins: (Ullrich-Luter et al., 2011)

GO TO NOTE REFERENCE IN TEXT

Weirder still, it's only an eye: (Sumner-Rooney et al., 2020)

GO TO NOTE REFERENCE IN TEXT

In one Spanish province alone: (Carrete et al., 2012)

GO TO NOTE REFERENCE IN TEXT

In 2012, Martin and his colleagues: (Martin, Portugal, and Murn, 2012)

GO TO NOTE REFERENCE IN TEXT

A soaring vulture: See Martin (2012), which also reviews and cites Martin's many papers on bird visual fields.

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"The human visual world": (Martin, 2012)

GO TO NOTE REFERENCE IN TEXT

Many animals have an area: (Moore et al., 2017; Baden, Euler, and Berens, 2020)

GO TO NOTE REFERENCE IN TEXT

When a chicken investigates: (Stamp Dawkins, 2002)

GO TO NOTE REFERENCE IN TEXT

Many birds of prey: (Mitkus et al., 2018)

GO TO NOTE REFERENCE IN TEXT

When a peregrine falcon: (Potier et al., 2017)

GO TO NOTE REFERENCE IN TEXT

The left half of a chick's brain: A wide range of experiments is reviewed in Rogers (2012).

GO TO NOTE REFERENCE IN TEXT

A seal's visual field: (Hanke, Römer, and Dehnhardt, 2006)

GO TO NOTE REFERENCE IN TEXT

Cows and other livestock: (Hughes, 1977)

GO TO NOTE REFERENCE IN TEXT

The same is true: An excellent review of regionalization in animal retinas is Baden, Euler, and Berens (2020).

GO TO NOTE REFERENCE IN TEXT

Elephants, hippos, rhinos, whales: (Mass and Supin, 1995; Baden, Euler, and Berens, 2020) GO TO NOTE REFERENCE IN TEXT
A whale's pupil doesn't constrict: (Mass and Supin, 2007)

GO TO NOTE REFERENCE IN TEXT

Chameleons don't have to turn: (Katz et al., 2015)

GO TO NOTE REFERENCE IN TEXT

Many male flies focus upward: (Perry and Desplan, 2016)

GO TO NOTE REFERENCE IN TEXT

The fish *Anableps anableps:* (Owens et al., 2012) GO TO NOTE REFERENCE IN TEXT
The brownsnout spookfish: (Partridge et al., 2014)

GO TO NOTE REFERENCE IN TEXT

So can the cock-eyed squid: (Thomas, Robison, and Johnsen, 2017)

GO TO NOTE REFERENCE IN TEXT

Meanwhile, the deep-sea crustacean *Streetsia:* (Meyer-Rochow, 1978) GO TO NOTE REFERENCE IN TEXT
If you can coax a killer fly: (Simons, 2020)

GO TO NOTE REFERENCE IN TEXT

By filming these pursuits: (Wardill et al., 2013)

GO TO NOTE REFERENCE IN TEXT

Their ultrafast hunts are guided: (Gonzalez-Bellido, Wardill, and Juusola, 2011)

GO TO NOTE REFERENCE IN TEXT

Compared to the photoreceptors of a fruit fly: (Gonzalez-Bellido, Wardill, and Juusola, 2011) GO TO NOTE REFERENCE IN TEXT
By contrast, it takes between 30: (Masland, 2017)

GO TO NOTE REFERENCE IN TEXT

In general, animals tend to have higher CFFs: (Laughlin and Weckström, 1993)

GO TO NOTE REFERENCE IN TEXT

Compared to human vision: Several values of animal CFFs can be found in Healy et al. (2013); Inger et al. (2014).

GO TO NOTE REFERENCE IN TEXT

Those of swordfish: (Fritsches, Brill, and Warrant, 2005)

GO TO NOTE REFERENCE IN TEXT

Many birds have naturally fast vision: (Boström et al., 2016)

GO TO NOTE REFERENCE IN TEXT

Traditional fluorescent lights flicker at 100 Hz: (Evans et al., 2012)

GO TO NOTE REFERENCE IN TEXT

And those insects have eyes: (Ruck, 1958)

GO TO NOTE REFERENCE IN TEXT

By filming the insect: (Warrant et al., 2004)

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The first is obvious: (O'Carroll and Warrant, 2017)

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The second challenge is less intuitive: (O'Carroll and Warrant, 2017)

GO TO NOTE REFERENCE IN TEXT

It takes a lot of energy: (Niven and Laughlin, 2008; Moran, Softley, and Warrant, 2015) GO TO NOTE REFERENCE IN TEXT
Others unsubscribe from vision entirely: (Porter and Sumner-Rooney, 2018)

GO TO NOTE REFERENCE IN TEXT

There are many ways to break an eye: (Porter and Sumner-Rooney, 2018)

GO TO NOTE REFERENCE IN TEXT

Some use neural tricks: (Warrant, 2017)

GO TO NOTE REFERENCE IN TEXT

The structure of a reindeer's tapetum: (Stokkan et al., 2013)

GO TO NOTE REFERENCE IN TEXT

The tarsiers—small primates: (Collins, Hendrickson, and Kaas, 2005)

GO TO NOTE REFERENCE IN TEXT

To dive into the ocean: (Warrant and Locket, 2004)

GO TO NOTE REFERENCE IN TEXT

At 10 meters down: Two great reviews about vision in the ocean are Warrant and Locket (2004); Johnsen (2014).

GO TO NOTE REFERENCE IN TEXT

To be more respectful of deep-sea: (Widder, 2019)

GO TO NOTE REFERENCE IN TEXT

The footage was unmistakable: (Johnsen and Widder, 2019)

GO TO NOTE REFERENCE IN TEXT

But no other creature: (Nilsson et al., 2012)

GO TO NOTE REFERENCE IN TEXT

Sonke Johnsen, Eric Warrant, and Dan-Eric Nilsson: (Nilsson et al., 2012)

GO TO NOTE REFERENCE IN TEXT

The first natural footage was captured in 2012: (Schrope, 2013)

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Then, in 2002, Eric Warrant: (Kelber, Balkenius, and Warrant, 2002)

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CHAPTER 3

One textbook claimed that: (Tansley, 1965)

GO TO NOTE REFERENCE IN TEXT

And yet, very few species: (Neitz, Geist, and Jacobs, 1989)

GO TO NOTE REFERENCE IN TEXT

Dogs do see color: (Neitz, Geist, and Jacobs, 1989)

GO TO NOTE REFERENCE IN TEXT

Light comes in a range: For excellent primers on color vision, check out Osorio and Vorobyev (2008); Cuthill et al. (2017); and Chapter 7 of Cronin et al. (2014).

GO TO NOTE REFERENCE IN TEXT

***Daphnia* water fleas:** A review of unusual color vision is Marshall and Arikawa (2014).

GO TO NOTE REFERENCE IN TEXT

Consider the story of the artist: (Sacks and Wasserman, 1987)

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Some, like sloths and armadillos: (Emerling and Springer, 2015)

GO TO NOTE REFERENCE IN TEXT

Others, like raccoons and sharks: (Peichl, 2005; Hart et al., 2011)

GO TO NOTE REFERENCE IN TEXT

Whales have just one cone, too: (Peichl, Behrmann, and Kröger, 2001)

GO TO NOTE REFERENCE IN TEXT

Surprisingly, the cephalopods: (Hanke and Kelber, 2020)

GO TO NOTE REFERENCE IN TEXT

The firefly squid: (Seidou et al., 1990)

GO TO NOTE REFERENCE IN TEXT

Physiologist Vadim Maximov suggested: (Maximov, 2000)

GO TO NOTE REFERENCE IN TEXT

Dogs have two cones: (Neitz, Geist, and Jacobs, 1989)

GO TO NOTE REFERENCE IN TEXT

This means that horses struggle: (Paul and Stevens, 2020)

GO TO NOTE REFERENCE IN TEXT

Color-blind people might be confused: (Colour Blind Awareness, n.d.)

GO TO NOTE REFERENCE IN TEXT

The first primates: (Carvalho et al., 2017)

GO TO NOTE REFERENCE IN TEXT

That's exactly what happened: (Carvalho et al., 2017)

GO TO NOTE REFERENCE IN TEXT

Each extra opsin increases: (Pointer and Attridge, 1998; Neitz, Carroll, and Neitz, 2001) GO TO NOTE REFERENCE IN TEXT
Since the nineteenth century: (Mollon, 1989; Osorio and Vorobyev, 1996; Smith et al., 2003) GO TO NOTE REFERENCE IN TEXT
More recently, some researchers: (Dominy and Lucas, 2001; Dominy, Svenning, and Li, 2003) GO TO NOTE REFERENCE IN TEXT
In 1984, Gerald Jacobs: (Jacobs, 1984)

GO TO NOTE REFERENCE IN TEXT

These monkeys never developed: (Jacobs and Neitz, 1987)

GO TO NOTE REFERENCE IN TEXT

Howler monkeys: (Saito et al., 2004)

GO TO NOTE REFERENCE IN TEXT

Females might inherit two: (Jacobs and Neitz, 1987)

GO TO NOTE REFERENCE IN TEXT

Neither group, she found: (Fedigan et al., 2014)

GO TO NOTE REFERENCE IN TEXT

The trichromats are indeed better: (Melin et al., 2007, 2017)

GO TO NOTE REFERENCE IN TEXT

In 2007, the Neitzes: (Mancuso et al., 2009)

GO TO NOTE REFERENCE IN TEXT

In the 1880s, John Lubbock: (Lubbock, 1881)

GO TO NOTE REFERENCE IN TEXT

There's only a narrow Goldilocks: (Dusenbery, 1992)

GO TO NOTE REFERENCE IN TEXT

At the time, some scientists: For an excellent overview on UV vision and its history, see Cronin and Bok (2016).

GO TO NOTE REFERENCE IN TEXT

But after another half century: (Goldsmith, 1980)

GO TO NOTE REFERENCE IN TEXT

Still wrong: In 1991: (Jacobs, Neitz, and Deegan, 1991)

GO TO NOTE REFERENCE IN TEXT

Not so: In the 2010s: (Douglas and Jeffery, 2014)

GO TO NOTE REFERENCE IN TEXT

This happened to the painter Claude Monet: (Zimmer, 2012) GO TO NOTE REFERENCE IN TEXT
Most animals that can see color: (Tedore and Nilsson, 2019) GO TO NOTE REFERENCE IN TEXT
Some scientists think: (Marshall, Carleton, and Cronin, 2015) GO TO NOTE REFERENCE IN TEXT

Reindeer can quickly: (Tyler et al., 2014)

GO TO NOTE REFERENCE IN TEXT

Flowers use dramatic UV patterns: (Primack, 1982)

GO TO NOTE REFERENCE IN TEXT

Crab spiders lurk: (Herberstein, Heiling, and Cheng, 2009) GO TO NOTE REFERENCE IN TEXT
In 1998, two independent teams: (Andersson, Ornborg, and Andersson, 1998; Hunt et al., 1998) GO TO NOTE REFERENCE IN TEXT
The same is true: (Eaton, 2005)

GO TO NOTE REFERENCE IN TEXT

The swordtail fish: (Cummings, Rosenthal, and Ryan, 2003) GO TO NOTE REFERENCE IN TEXT
But Ulrike Siebeck found: (Siebeck et al., 2010)

GO TO NOTE REFERENCE IN TEXT

Scientists have often attributed: (Stevens and Cuthill, 2007) GO TO NOTE REFERENCE IN TEXT
In 1995, a Finnish team: (Viitala et al., 1995)

GO TO NOTE REFERENCE IN TEXT

In 2013, she and her colleagues: (Lind et al., 2013)

GO TO NOTE REFERENCE IN TEXT

Exploiting the hummingbirds' natural instinct: (Stoddard et al., 2020) GO TO NOTE REFERENCE IN TEXT
Picture trichromatic human vision: A classic paper on visualizing color vision is Kelber, Vorobyev, and Osorio (2003).

GO TO NOTE REFERENCE IN TEXT

Stoddard found that these non-spectral: (Stoddard et al., 2020) GO TO NOTE REFERENCE IN TEXT
Many supposedly "white" bird feathers: (Stoddard et al., 2019) GO TO NOTE REFERENCE IN TEXT
Reptiles, insects, and freshwater fish: (Neumeyer, 1992)

GO TO NOTE REFERENCE IN TEXT

By looking at tetrachromats: (Collin et al., 2009)

GO TO NOTE REFERENCE IN TEXT

In any one place, these two species: (Hines et al., 2011) GO TO NOTE REFERENCE IN TEXT
But in 2010, Briscoe discovered: (Briscoe et al., 2010)

GO TO NOTE REFERENCE IN TEXT

Even birds, with their single UV opsin: (Finkbeiner et al., 2017) GO TO NOTE REFERENCE IN TEXT
In 2016, Briscoe's student: (McCulloch, Osorio, and Briscoe, 2016) GO TO NOTE REFERENCE IN TEXT
Somewhere in Newcastle, England: (Jordan et al., 2010)

GO TO NOTE REFERENCE IN TEXT

Around one in eight women: (Greenwood, 2012; Jordan and Mollon, 2019) GO TO NOTE REFERENCE IN TEXT
At least three kinds: (Zimmermann et al., 2018)

GO TO NOTE REFERENCE IN TEXT

Kentaro Arikawa has found: (Koshitaka et al., 2008; Chen et al., 2016; Arikawa, 2017) GO TO NOTE REFERENCE IN TEXT
The clubs of a large smasher: (Patek, Korff, and Caldwell, 2004) GO TO NOTE REFERENCE IN TEXT
When Marshall looked at the midband: (Marshall, 1988)

GO TO NOTE REFERENCE IN TEXT

And to their shock: (Cronin and Marshall, 1989a, 1989b)

GO TO NOTE REFERENCE IN TEXT

The midband consists: An excellent review of mantis shrimp vision is Cronin, Marshall, and Caldwell (2017).

GO TO NOTE REFERENCE IN TEXT

Mantis shrimps have more classes: (Marshall and Oberwinkler, 1999; Bok et al., 2014) GO TO NOTE REFERENCE IN TEXT

The Oatmeal: (Inman, 2013) GO TO NOTE REFERENCE IN TEXT
In 2014, Marshall's student: (Thoen et al., 2014)

GO TO NOTE REFERENCE IN TEXT

Nigel's eyes are constantly moving: (Daly et al., 2018)

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Mantis shrimps do something similar: (Marshall, Land, and Cronin, 2014).

GO TO NOTE REFERENCE IN TEXT

When it spots something: (Land et al., 1990)

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Humans are largely oblivious: (Marshall et al., 2019b)

GO TO NOTE REFERENCE IN TEXT

Cephalopods are more sensitive: (Temple et al., 2012)

GO TO NOTE REFERENCE IN TEXT

And as Marshall's postdoc: (Chiou et al., 2008)

GO TO NOTE REFERENCE IN TEXT

They can also rotate their eyes: (Daly et al., 2016)

GO TO NOTE REFERENCE IN TEXT

One species reflects it: (Gagnon et al., 2015)

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Tom Cronin thinks: (Cronin, 2018)

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The red faces: (Hiramatsu et al., 2017; Moreira et al., 2019) GO TO NOTE REFERENCE IN TEXT
But the fish themselves: (Marshall et al., 2019a)

GO TO NOTE REFERENCE IN TEXT

But as Molly Cummings: (Maan and Cummings, 2012)

GO TO NOTE REFERENCE IN TEXT

In 1992, Lars Chittka: (Chittka and Menzel, 1992)

GO TO NOTE REFERENCE IN TEXT

Their style of trichromacy: (Chittka, 1997)

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CHAPTER 4

I highly recommend the paper: (Braude et al., 2021)

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Naked mole-rats are so weird: (Park, Lewin, and Buffenstein, 2010; Braude et al., 2021) GO TO NOTE REFERENCE IN TEXT
Their lower incisors: (Catania and Remple, 2002)

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Their sperm are misshapen: (Van der Horst et al., 2011)

GO TO NOTE REFERENCE IN TEXT

They can survive for up: (Park et al., 2017)

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They've also been forced: (Zions et al., 2020)

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Park demonstrated this with: an arena: (Park et al., 2017) GO TO NOTE REFERENCE IN TEXT
They'll sniff strong vinegary fumes: (LaVinka and Park, 2012) GO TO NOTE REFERENCE IN TEXT
They don't register drops of acid: (Park et al., 2008)

GO TO NOTE REFERENCE IN TEXT

They dislike pinches and burns: (Poulson et al., 2020)

GO TO NOTE REFERENCE IN TEXT

Our experience of pain depends: The basics of nociception are reviewed in Kavaliers (1988); Lewin, Lu, and Park (2004); Tracey (2017).

GO TO NOTE REFERENCE IN TEXT

But theirs are fewer in number: (Smith, Park, and Lewin, 2020) GO TO NOTE REFERENCE IN TEXT
Those that would normally be activated: (Smith et al., 2011) GO TO NOTE REFERENCE IN TEXT
Several hibernating mammals: (Liu et al., 2014)

GO TO NOTE REFERENCE IN TEXT

Birds that carry the seeds: (Jordt and Julius, 2002)

GO TO NOTE REFERENCE IN TEXT

Humans are insensitive to nepetalactone: (Melo et al., 2021) GO TO NOTE REFERENCE IN TEXT

The grasshopper mouse: (Rowe et al., 2013)

GO TO NOTE REFERENCE IN TEXT

In the early 1900s: (Sherrington, 1903)

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Over a century later: Excellent reviews of nociception and pain are Sneddon (2018); Williams et al. (2019).

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Other people are congenitally indifferent: (Cox et al., 2006; Goldberg et al., 2012)

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One Pakistani boy: (Cox et al., 2006)

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I highly recommend Leigh Cowart's: (Cowart, 2021)

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People (and especially women): *The Lady's Handbook for Her Mysterious Illness* by Sarah Ramey (2020) and *Doing Harm* by Maya Dusenbery (2018) are excellent books on this topic.

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It is so widespread and consistent: A review of pain in animals is Sneddon (2018).

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The signs of pain: (Bateson, 1991)

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For many historical thinkers: (Sullivan, 2013)

GO TO NOTE REFERENCE IN TEXT

But fierce debates are still raging: (Sneddon et al., 2014) GO TO NOTE REFERENCE IN TEXT
Until the 1980s: (Anand, Sippell, and Aynsley-Green, 1987) GO TO NOTE REFERENCE IN TEXT
That distinction "is a relic": (Broom, 2001)

GO TO NOTE REFERENCE IN TEXT

Humans have taste receptors: (Li, 2013; Lu et al., 2017)

GO TO NOTE REFERENCE IN TEXT

In the early 2000s, Lynne Sneddon: (Sneddon, Braithwaite, and Gentle, 2003a, 2003b) GO TO NOTE REFERENCE IN TEXT
When fish nociceptors fire: (Dunlop and Laming, 2005; Reilly et al., 2008) GO TO NOTE REFERENCE IN TEXT
Sure enough, when the animals: (Bjørge et al., 2011; Mettam et al., 2011) GO TO NOTE REFERENCE IN TEXT
In one experiment, Sneddon showed: (Sneddon, 2013)

GO TO NOTE REFERENCE IN TEXT

In another study, Sarah Millsopp: (Millsopp and Laming, 2008) GO TO NOTE REFERENCE IN TEXT
"There is as much evidence": (Braithwaite, 2010)

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But a group of vocal critics: (Rose et al., 2014; Key, 2016) GO TO NOTE REFERENCE IN TEXT
For a sense of the debate: (Rose et al., 2014; Key, 2016; Sneddon, 2019) GO TO NOTE REFERENCE IN TEXT
"Fishes are neurologically equipped": (Rose et al., 2014) GO TO NOTE REFERENCE IN TEXT
Ironically, this argument: (Braithwaite and Droege, 2016) GO TO NOTE REFERENCE IN TEXT
And by the same faulty logic: (Dinets, 2016)

GO TO NOTE REFERENCE IN TEXT

For perspective, crabs and lobsters: (Marder and Bucher, 2007) GO TO NOTE REFERENCE IN TEXT
What matters is not just the total tally: (Garcia-Larrea and Bastuji, 2018) GO TO NOTE REFERENCE IN TEXT
But such links are much sparser: (Adamo, 2016, 2019)

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But Elwood and his colleague: (Appel and Elwood, 2009; Elwood and Appel, 2009) GO TO NOTE REFERENCE IN TEXT
These data, Elwood says: (Elwood, 2019)

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But notably, Adamo, Sneddon, and Elwood: (Sneddon et al., 2014) GO TO NOTE REFERENCE IN TEXT
Evolution has pushed: (Chittka and Niven, 2009)

GO TO NOTE REFERENCE IN TEXT

Some scientists suggest: (Bateson, 1991; Elwood, 2011)

GO TO NOTE REFERENCE IN TEXT

Engineers have designed robots: (Stiehl, Lalla, and Breazeal, 2004; Lee-Johnson and Carnegie, 2010; Ikinamo, 2011) GO TO NOTE REFERENCE IN TEXT
But they also have: (Hochner, 2012)

GO TO NOTE REFERENCE IN TEXT

And, as the EU noted: (European Parliament, Council of the European Union, 2010) GO TO NOTE REFERENCE IN TEXT
She began to bridge that gap: (Crook et al., 2011)

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Even more surprisingly, Crook found: (Crook, Hanlon, and Walters, 2013) GO TO NOTE REFERENCE IN TEXT
By setting their entire bodies: (Crook et al., 2014)

GO TO NOTE REFERENCE IN TEXT

Crook confirmed this: (Alupay, Hadjisolomou, and Crook, 2014) GO TO NOTE REFERENCE IN TEXT
Octopuses will sometimes break off: (Alupay, Hadjisolomou, and Crook, 2014) GO TO NOTE REFERENCE IN TEXT
In her latest study: (Crook, 2021)

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“We could simply accept”: (Chatigny, 2019)

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Insects, for example: (Eisemann et al., 1984)

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These behaviors “strongly suggest”: (Eisemann et al., 1984) GO TO NOTE REFERENCE IN TEXT

CHAPTER 5

Hibernation isn't sleep: (Geiser, 2013)

GO TO NOTE REFERENCE IN TEXT

The two processes are so different: (Daan, Barnes, and Strijkstra, 1991) GO TO NOTE REFERENCE IN TEXT
Its heart, which beats: (Andrews, 2019)

GO TO NOTE REFERENCE IN TEXT

A thirteen-lined ground squirrel: (Matos-Cruz et al., 2017) GO TO NOTE REFERENCE IN TEXT
Vanessa Matos-Cruz, who worked with Gracheva: (Matos-Cruz et al., 2017) GO TO NOTE REFERENCE IN TEXT
The limits of that zone vary: The temperature ranges that animals tolerate are reviewed in McKemy (2007); Sengupta and Garrity (2013).

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Animals use a variety: (Matos-Cruz et al., 2017; Hoffstaetter, Bagriantsev, and Gracheva, 2018) GO TO NOTE REFERENCE IN TEXT
In a rat, that set point: (Hoffstaetter, Bagriantsev, and Gracheva, 2018) GO TO NOTE REFERENCE IN TEXT
Fish seem to lack TRPM8 altogether: (Gracheva and Bagriantsev, 2015) GO TO NOTE REFERENCE IN TEXT
Matos-Cruz found that: (Matos-Cruz et al., 2017)

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There's a version of: the human TRPM8: (Key et al., 2018) GO TO NOTE REFERENCE IN TEXT
The TRPV1 sensor: (Hoffstaetter, Bagriantsev, and Gracheva, 2018) GO TO NOTE REFERENCE IN TEXT
In Gracheva's hotplate tests: (Laursen et al., 2016)

GO TO NOTE REFERENCE IN TEXT

The Saharan silver ant: (Gehring and Wehner, 1995; Ravaux et al., 2013) GO TO NOTE REFERENCE IN TEXT
Snow flies are active: (Hartzell et al., 2011)

GO TO NOTE REFERENCE IN TEXT

The air 5 millimeters above: (Corfas and Vosshall, 2015)

GO TO NOTE REFERENCE IN TEXT

If it landed on my head: (Heinrich, 1993)

GO TO NOTE REFERENCE IN TEXT

Neuroscientist Marco Gallio demonstrated: (Simões et al., 2021) GO TO NOTE REFERENCE IN TEXT
Fish, from tiny larvae: (Wurtsbaugh and Neverman, 1988; Thums et al., 2013) GO TO NOTE REFERENCE IN TEXT
Sulfide worms that live: (Bates et al., 2010)

GO TO NOTE REFERENCE IN TEXT

Butterflies that are warming: (Tsai et al., 2020)

GO TO NOTE REFERENCE IN TEXT

Turtle embryos can even: (Du et al., 2011)

GO TO NOTE REFERENCE IN TEXT

At 11:20 A.M. on August 10, 1925: (Schmitz and Bousack, 2012) GO TO NOTE REFERENCE IN TEXT
These black, half-inch-long insects: (Linsley, 1943)

GO TO NOTE REFERENCE IN TEXT

One summer, Linsley saw them: (Linsley and Hurd, 1957)

GO TO NOTE REFERENCE IN TEXT

Arriving at a fire: (Schmitz, Schmitz, and Schneider, 2016) GO TO NOTE REFERENCE IN TEXT
And though their antennae: (Schütz et al., 1999)

GO TO NOTE REFERENCE IN TEXT

The atoms and molecules: (Dusenbery, 1992; Schmitz, Schmitz, and Schneider, 2016) GO TO NOTE REFERENCE IN TEXT
When zoologist Helmut Schmitz: (Schmitz and Bleckmann, 1998) GO TO NOTE REFERENCE IN TEXT
Based on this distance: (Schmitz and Bousack, 2012)

GO TO NOTE REFERENCE IN TEXT

During flight, their beating wings: (Schneider, Schmitz, and Schmitz, 2015) GO TO NOTE REFERENCE IN TEXT
The 11 species of *Melanophila:* (Schmitz, Schmitz, and Schneider, 2016) GO TO NOTE REFERENCE IN TEXT
The exceptions include the species: (Bisoffi et al., 2013) GO TO NOTE REFERENCE IN TEXT
So is heat: (Bryant and Hallem, 2018; Bryant et al., 2018) GO TO NOTE REFERENCE IN TEXT
It's likely that the majority: (Windsor, 1998; Forbes et al., 2018) GO TO NOTE REFERENCE IN TEXT
It's no surprise that at least: (Lazzari, 2009; Chappuis et al., 2013; Corfas and Vosshall, 2015) GO TO NOTE REFERENCE IN TEXT
The vampire's heat sensors: (Kürten and Schmidt, 1982)

GO TO NOTE REFERENCE IN TEXT

Elena Gracheva studied those neurons: (Gracheva et al., 2011) GO TO NOTE REFERENCE IN TEXT
Ann Carr and Vincent Salgado: (Carr and Salgado, 2019)

GO TO NOTE REFERENCE IN TEXT

Heat-sensitive pits have evolved: (Goris, 2011)

GO TO NOTE REFERENCE IN TEXT

And yet, Elena Gracheva: found: (Gracheva et al., 2010)

GO TO NOTE REFERENCE IN TEXT

No one hit on the right answer: (Ros, 1935)

GO TO NOTE REFERENCE IN TEXT

Rattlesnakes will strike at warm objects: (Noble and Schmidt, 1937) GO TO NOTE REFERENCE IN TEXT
Even a congenitally blind rattlesnake: (Kardong and Mackessy, 1991) GO TO NOTE REFERENCE IN TEXT
They'll respond if the membrane: (Bullock and Diecke, 1956) GO TO NOTE REFERENCE IN TEXT
This astonishing sensitivity means: (Ebert and Westhoff, 2006) GO TO NOTE REFERENCE IN TEXT
There, the two streams are combined: (Hartline, Kass, and Loop, 1978; Newman and Hartline, 1982) GO TO NOTE REFERENCE IN TEXT
"It is a fallacy": (Goris, 2011)

GO TO NOTE REFERENCE IN TEXT

When confronted, they raise their tails: (Rundus et al., 2007) GO TO NOTE REFERENCE IN TEXT
He got grainy images: (Bakken and Krochmal, 2007)

GO TO NOTE REFERENCE IN TEXT

Sidewinders tend to point: (Schraft, Bakken, and Clark, 2019) GO TO NOTE REFERENCE IN TEXT
And on China's Shedao Island: (Shine et al., 2002)

GO TO NOTE REFERENCE IN TEXT

Chinese herpetologist Yezhong Tang: (Chen et al., 2012)

GO TO NOTE REFERENCE IN TEXT

The nerves in their membranes: (Goris, 2011)

GO TO NOTE REFERENCE IN TEXT

Ecologist Burt Kotler: (Bleicher et al., 2018; Embar et al., 2018) GO TO NOTE REFERENCE IN TEXT
But Schraft found that blindfolded sidewinders: (Schraft and Clark, 2019) GO TO NOTE REFERENCE IN TEXT
Schraft presented them with lizard carcasses: (Schraft, Goodman, and Clark, 2018) GO TO NOTE REFERENCE IN TEXT
In 2013, Viviana Cadena: (Cadena et al., 2013)

GO TO NOTE REFERENCE IN TEXT

In a refreshing act of: (Bakken et al., 2018)

GO TO NOTE REFERENCE IN TEXT

Kröger found that: (Gläser and Kröger, 2017; Kröger and Goiricelaya, 2017) GO TO NOTE REFERENCE IN TEXT
His team successfully trained three dogs: (Bálint et al., 2020) GO TO NOTE REFERENCE IN TEXT

CHAPTER 6

Orphaned and stranded: (Monterey Bay Aquarium, 2016)

GO TO NOTE REFERENCE IN TEXT

They do have the densest fur: (Kuhn et al., 2010)

GO TO NOTE REFERENCE IN TEXT

To stay warm: (Costa and Kooyman, 2011)

GO TO NOTE REFERENCE IN TEXT

They're always diving: (Yeates, Williams, and Fink, 2007) GO TO NOTE REFERENCE IN TEXT
The sensitivity of their paws: (Radinsky, 1968)

GO TO NOTE REFERENCE IN TEXT

Different sections of the somatosensory cortex: (Wilson and Moore, 2015) GO TO NOTE REFERENCE IN TEXT
To measure what these mittens: (Strobel et al., 2018)

GO TO NOTE REFERENCE IN TEXT

Likewise, Strobel found that humans: (Strobel et al., 2018) GO TO NOTE REFERENCE IN TEXT
It will only stay submerged: (Thometz et al., 2016)

GO TO NOTE REFERENCE IN TEXT

Touch is one of the mechanical senses: A review of touch is Prescott and Dürr (2015).

GO TO NOTE REFERENCE IN TEXT

These cells come in several varieties: The various kinds of touch sensors are reviewed in Zimmerman, Bai, and Ginty (2014); Moayedi, Nakatani, and Lumpkin (2015).

GO TO NOTE REFERENCE IN TEXT

But exactly how this happens: (Walsh, Bautista, and Lumpkin, 2015) GO TO NOTE REFERENCE IN TEXT
In one experiment: (Carpenter et al., 2018)

GO TO NOTE REFERENCE IN TEXT

In another test: (Skedung et al., 2013)

GO TO NOTE REFERENCE IN TEXT

These incredible feats are possible: (Prescott, Diamond, and Wing, 2011) GO TO NOTE REFERENCE IN TEXT
Mark Rutland, who led: (Skedung et al., 2013)

GO TO NOTE REFERENCE IN TEXT

The star-nosed mole: Catania's account of his work with the star-nosed mole is Catania (2011).

GO TO NOTE REFERENCE IN TEXT

Scientists have long speculated: (Catania, 1995b)

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A star-nosed mole embryo: (Catania, Northcutt, and Kaas, 1999) GO TO NOTE REFERENCE IN TEXT
The mole's somatosensory cortex: (Catania et al., 1993)

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Around 5 percent of star-nosed moles: (Catania and Kaas, 1997b) GO TO NOTE REFERENCE IN TEXT
The 11th pair of rays: (Catania, 1995a)

GO TO NOTE REFERENCE IN TEXT

By filming the mole: (Catania and Kaas, 1997a)

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By analyzing such footage: (Catania and Remple, 2004, 2005) GO TO NOTE REFERENCE IN TEXT
In chickens, which rely heavily: (Gentle and Breward, 1986) GO TO NOTE REFERENCE IN TEXT
But in some ducks: (Schneider et al., 2014, 2017)

GO TO NOTE REFERENCE IN TEXT

“Imagine being given a bowl”: (Birkhead, 2013, p. 78)

GO TO NOTE REFERENCE IN TEXT

Compared to other ducks: (Schneider et al., 2019)

GO TO NOTE REFERENCE IN TEXT

But in 1995, Theunis Piersma: (Piersma et al., 1995)

GO TO NOTE REFERENCE IN TEXT

This simple experiment revealed: (Piersma et al., 1998)

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Ibises use the technique: (Cunningham, Castro, and Alley, 2007; Cunningham et al., 2010) GO TO NOTE REFERENCE IN TEXT
Ram Gal and Frederic Libersat: (Gal et al., 2014)

GO TO NOTE REFERENCE IN TEXT

The remoras, or suckerfishes: (Cohen et al., 2020)

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The round goby: (Hardy and Hale, 2020)

GO TO NOTE REFERENCE IN TEXT

The whiskered auklet: (Seneviratne and Jones, 2008)

GO TO NOTE REFERENCE IN TEXT

When Sampath Seneviratne placed: (Seneviratne and Jones, 2008) GO TO NOTE REFERENCE IN TEXT
It’s more likely that they’re touch sensors: (Cunningham, Alley, and Castro, 2011) GO TO NOTE REFERENCE IN TEXT
It’s clear that birds evolved: (Persons and Currie, 2015) GO TO NOTE REFERENCE IN TEXT
Mammalian hair might have: (Prescott and Dürr, 2015)

GO TO NOTE REFERENCE IN TEXT

They’re called vibrissae: A review of mammalian vibrissae is Prescott, Mitchinson, and Grant (2011).

GO TO NOTE REFERENCE IN TEXT

This action, delightfully known as whisking: (Bush, Solla, and Hartmann, 2016) GO TO NOTE REFERENCE IN TEXT
The rodent constantly scans: (Grant, Breakell, and Prescott, 2018) GO TO NOTE REFERENCE IN TEXT
If it senses something: (Grant, Sperber, and Prescott, 2012) GO TO NOTE REFERENCE IN TEXT
If we turn our: head: (Arkley et al., 2014)

GO TO NOTE REFERENCE IN TEXT

Mammals have been using whiskers: (Mitchinson et al., 2011) GO TO NOTE REFERENCE IN TEXT
Grant showed that the opossum: (Mitchinson et al., 2011)

GO TO NOTE REFERENCE IN TEXT

The disk is muscular: (Marshall, Clark, and Reep, 1998)

GO TO NOTE REFERENCE IN TEXT

There are around 2,000: The vibrissae of manatees are reviewed in Reep and Sarko (2009); Bauer, Reep, and Marshall (2018).

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But when it’s time to eat: (Marshall et al., 1998)

GO TO NOTE REFERENCE IN TEXT

In 2012, Bauer tested Hugh: (Bauer et al., 2012)

GO TO NOTE REFERENCE IN TEXT

A few other mammals: (Crish, Crish, and Comer, 2015; Sarko, Rice, and Reep, 2015) GO TO NOTE REFERENCE IN TEXT
Manatees use these body-wide whiskers: (Reep, Marshall, and Stoll, 2002) GO TO NOTE REFERENCE IN TEXT
Bauer and his colleagues: (Gaspard et al., 2017)

GO TO NOTE REFERENCE IN TEXT

Sprouts has around a hundred facial whiskers: (Hanke and Dehnhardt, 2015) GO TO NOTE REFERENCE IN TEXT
Sprouts can use them: (Murphy, Reichmuth, and Mann, 2015) GO TO NOTE REFERENCE IN TEXT
The seals actively keep: the whiskers: (Dehnhardt, Mauck, and Hyvärinen, 1998) GO TO NOTE REFERENCE IN TEXT
This ability was only discovered in 2001: (Dehnhardt et al., 2001) GO TO NOTE REFERENCE IN TEXT
The Rostock team: showed: (Hanke et al., 2010)

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From those impressions alone: (Wieskotten et al., 2010)

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It can discriminate between the wakes: (Wieskotten et al., 2011) GO TO NOTE REFERENCE IN TEXT
In one experiment, Henry: (Niesterok et al., 2017)

GO TO NOTE REFERENCE IN TEXT

The lateral line is found: A review of the lateral line is Montgomery, Bleckmann, and Coombs (2013).

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After describing the pores: (Dijkgraaf, 1989)

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In the 1930s, the biologist: (Dijkgraaf, 1989)

GO TO NOTE REFERENCE IN TEXT

In 1908, the ichthyologist Bruno Hofer: (Hofer, 1908)

GO TO NOTE REFERENCE IN TEXT

If it swims toward an aquarium: (Dijkgraaf, 1963)

GO TO NOTE REFERENCE IN TEXT

In 1963, Dijkgraaf summarized: (Dijkgraaf, 1963)

GO TO NOTE REFERENCE IN TEXT

With the lateral line: (Webb, 2013; Mogdans, 2019)

GO TO NOTE REFERENCE IN TEXT

Schooling fish use their lateral lines: (Partridge and Pitcher, 1980) GO TO NOTE REFERENCE IN TEXT
Blind fish can still school: (Pitcher, Partridge, and Wardle, 1976) GO TO NOTE REFERENCE IN TEXT
Though all fish share: (Webb, 2013)

GO TO NOTE REFERENCE IN TEXT

Surface-feeding fish: (Mogdans, 2019)

GO TO NOTE REFERENCE IN TEXT

Halfbeaks have massive underbites: (Montgomery and Saunders, 1985) GO TO NOTE REFERENCE IN TEXT
Blind cavefish have lost their sight: (Yoshizawa et al., 2014; Lloyd et al., 2018) GO TO NOTE REFERENCE IN TEXT
Some blind cavefish have evolved: (Patton, Windsor, and Coombs, 2010) GO TO NOTE REFERENCE IN TEXT
Examining it under a microscope: (Haspel et al., 2012)

GO TO NOTE REFERENCE IN TEXT

Soares showed that the joysticks: (Haspel et al., 2012)

GO TO NOTE REFERENCE IN TEXT

The bumps, she discovered: (Soares, 2002)

GO TO NOTE REFERENCE IN TEXT

Crocodilians—alligators, crocodiles: (Soares, 2002)

GO TO NOTE REFERENCE IN TEXT

And yet, they are covered: (Leitch and Catania, 2012)

GO TO NOTE REFERENCE IN TEXT

Many snakes have thousands: (Crowe-Riddell, Williams, et al., 2019) GO TO NOTE REFERENCE IN TEXT
***Spinosaurus,* an enormous sail-backed dinosaur:** (Ibrahim et al., 2014) GO TO NOTE REFERENCE IN TEXT
Daspletosaurus,* a close relative of *Tyrannosaurus: (Carr et al., 2017) GO TO NOTE REFERENCE IN TEXT
To find out if they: (Kane, Van Beveren, and Dakin, 2018) GO TO NOTE REFERENCE IN TEXT
These results suggest that a peahen: (Kane, Van Beveren, and Dakin, 2018) GO TO NOTE REFERENCE IN TEXT
But filoplumes are especially important: (Necker, 1985; Clark and de Cruz, 1989) GO TO NOTE REFERENCE IN TEXT
This rarely happens, in part because filoplumes: (Brown and Fedde, 1993) GO TO NOTE REFERENCE IN TEXT
They are covered with a smattering: (Sterbing-D'Angelo et al., 2017) GO TO NOTE REFERENCE IN TEXT
When Sterbing treated bat wings: (Sterbing-D'Angelo and Moss, 2014) GO TO NOTE REFERENCE IN TEXT
In 1960, a shipment of bananas: Barth's account of his work with the tiger wandering spider is Barth (2002).

GO TO NOTE REFERENCE IN TEXT

Its legs are covered in hundreds: (Barth, 2015)

GO TO NOTE REFERENCE IN TEXT

If it is running: (Seyfarth, 2002)

GO TO NOTE REFERENCE IN TEXT

Even air that's moving: (Barth and Höller, 1999)

GO TO NOTE REFERENCE IN TEXT

It grabs the fly from the air: (Klopsch, Kuhlmann, and Barth, 2012, 2013) GO TO NOTE REFERENCE IN TEXT
Many have airflow sensors: (Casas and Dangles, 2010)

GO TO NOTE REFERENCE IN TEXT

It is fast, but Casas found: (Dangles, Casas, and Coolen, 2006; Casas and Steinmann, 2014) GO TO NOTE REFERENCE IN TEXT
"Spiders can detect danger": (Di Silvestro, 2012)

GO TO NOTE REFERENCE IN TEXT

These hairs are a hundred times: (Shimozawa, Murakami, and Kumagai, 2003) GO TO NOTE REFERENCE IN TEXT
For example, in 1978, Jürgen Tautz: (Tautz and Markl, 1978) GO TO NOTE REFERENCE IN TEXT
Thirty years later, Tautz showed: (Tautz and Rostás, 2008) GO TO NOTE REFERENCE IN TEXT

CHAPTER 7

They collected batches of eggs: (Warkentin, 1995)

GO TO NOTE REFERENCE IN TEXT

Their experiments showed: (Cohen, Seid, and Warkentin, 2016)

GO TO NOTE REFERENCE IN TEXT

By recording different vibrations: (Warkentin, 2005; Caldwell, McDaniel, and Warkentin, 2010) GO TO NOTE REFERENCE IN TEXT
They can clearly sense the world: A review of environmentally cued hatching in embryos is Warkentin (2011).

GO TO NOTE REFERENCE IN TEXT

But they don't respond to snakes: (Jung et al., 2019)

GO TO NOTE REFERENCE IN TEXT

So Jung built a jury-rigged: (Jung et al., 2019)

GO TO NOTE REFERENCE IN TEXT

By watching them with infrared cameras: (Caldwell, McDaniel, and Warkentin, 2010) GO TO NOTE REFERENCE IN TEXT
Male fiddler crabs: (Takeshita and Murai, 2016)

GO TO NOTE REFERENCE IN TEXT

Termite soldiers drum their heads: (Hager and Kirchner, 2013) GO TO NOTE REFERENCE IN TEXT
Water striders—insects that skate: (Han and Jablonski, 2010) GO TO NOTE REFERENCE IN TEXT
Scientists call these substrate-borne vibrations: (Hill, 2009; Hill and Wessel, 2016; Mortimer, 2017) GO TO NOTE REFERENCE IN TEXT
Surface waves, by contrast: (Hill, 2014)

GO TO NOTE REFERENCE IN TEXT

"We have encountered it, but": A seminal text by Peggy Hill about vibrational communication is Hill (2008). The quote appears on page 2.

GO TO NOTE REFERENCE IN TEXT

By rapidly contracting muscles: Insect vibrational communication is reviewed in Cocroft and Rodríguez (2005); Cocroft (2011).

GO TO NOTE REFERENCE IN TEXT

Insects exploit that property: (Cokl and Virant-Doberlet, 2003) GO TO NOTE REFERENCE IN TEXT
Cocroft now has a library: It can be found at treehoppers.insectmuseum.org.

GO TO NOTE REFERENCE IN TEXT

A treehopper can produce: (Cocroft and Rodríguez, 2005)

GO TO NOTE REFERENCE IN TEXT

Some babies produce synchronized vibrations: (Cocroft, 1999) GO TO NOTE REFERENCE IN TEXT
Some mothers produce vibrations: (Hamel and Cocroft, 2012) GO TO NOTE REFERENCE IN TEXT
They court each other: (Legendre, Marting, and Cocroft, 2012) GO TO NOTE REFERENCE IN TEXT
Many duetting insects will jam: (Eriksson et al., 2012; Polajnar et al., 2015) GO TO NOTE REFERENCE IN TEXT
Masked birch caterpillars scrape: (Yadav, 2017)

GO TO NOTE REFERENCE IN TEXT

Acacia ants vigorously defend: (Hager and Krausa, 2019)

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In 1949, three decades before: (Ossiannilsson, 1949)

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“Gentle disturbances of the sand”: Brownell’s account of his sand scorpion work is Brownell (1984).

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Brownell and Farley tested this idea: (Brownell and Farley, 1979c) GO TO NOTE REFERENCE IN TEXT
Its sensors lie in its feet: (Brownell and Farley, 1979a) GO TO NOTE REFERENCE IN TEXT

The first time this happens: (Brownell and Farley, 1979b) GO TO NOTE REFERENCE IN TEXT
Can animals sense earthquakes: (Woith et al., 2018)

GO TO NOTE REFERENCE IN TEXT

The footfalls of an ant: (Fertin and Casas, 2007; Martinez et al., 2020) GO TO NOTE REFERENCE IN TEXT
It reacts by tossing sand: (Mencinger-Vračko and Devetak, 2008) GO TO NOTE REFERENCE IN TEXT
Ken Catania—the same man: (Catania, 2008; Mitra et al., 2009) GO TO NOTE REFERENCE IN TEXT
“if the ground is beaten”: (Darwin, 1890)

GO TO NOTE REFERENCE IN TEXT

But it is highly sensitive: (Mason, 2003)

GO TO NOTE REFERENCE IN TEXT

The golden mole forages at night: (Lewis et al., 2006)

GO TO NOTE REFERENCE IN TEXT

Peter Narins has suggested: (Narins and Lewis, 1984; Mason and Narins, 2002) GO TO NOTE REFERENCE IN TEXT
The golden mole’s version: (Mason, 2003)

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“The lying about”: (Hill, 2008, p. 120)

GO TO NOTE REFERENCE IN TEXT

In the early 1990s, Caitlin O’Connell: O’Connell’s account of her own elephant work is O’Connell (2008).

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The animals seemed to be listening: (O’Connell-Rodwell, Hart, and Arnason, 2001) GO TO NOTE REFERENCE IN TEXT
In 2002, O’Connell returned: (O’Connell-Rodwell et al., 2006) GO TO NOTE REFERENCE IN TEXT
“All these years of planning”: (O’Connell, 2008, p. 180)

GO TO NOTE REFERENCE IN TEXT

A few years later, she repeated: (O'Connell-Rodwell et al., 2007) GO TO NOTE REFERENCE IN TEXT
The vibrations can travel over: (O'Connell, Arnason, and Hart, 1997; Günther, O'Connell-Rodwell, and Klemperer, 2004) GO TO NOTE REFERENCE IN TEXT
As we spread around the globe: (Smith et al., 2018)

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Between 30 and 60 million bison: (Phippen, 2016)

GO TO NOTE REFERENCE IN TEXT

"The Lakota…loved the earth": (Standing Bear, 2006, p. 192) GO TO NOTE REFERENCE IN TEXT
Spiders have been around: An excellent book on spider silk and its evolution is Brunetta and Craig (2012).

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Though light and elastic: (Agnarsson, Kuntner, and Blackledge, 2010) GO TO NOTE REFERENCE IN TEXT
The orb web is a trap: (Blackledge, Kuntner, and Agnarsson, 2011) GO TO NOTE REFERENCE IN TEXT
From this position: (Masters, 1984)

GO TO NOTE REFERENCE IN TEXT

They can probably work out: (Landolfa and Barth, 1996)

GO TO NOTE REFERENCE IN TEXT

They can assess the size: (Robinson and Mirick, 1971; Suter, 1978) GO TO NOTE REFERENCE IN TEXT
If the prey stops moving: (Klärner and Barth, 1982)

GO TO NOTE REFERENCE IN TEXT

The small dewdrop spider *Argyrodes:* (Vollrath, 1979a, 1979b) GO TO NOTE REFERENCE IN TEXT
Some assassin bugs: (Wignall and Taylor, 2011)

GO TO NOTE REFERENCE IN TEXT

***Portia,* a jumping spider:** (Wilcox, Jackson, and Gentile, 1996) GO TO NOTE REFERENCE IN TEXT
“a small woven world”: (Barth, 2002, p. 19)

GO TO NOTE REFERENCE IN TEXT

By using gas guns: (Mortimer et al., 2014)

GO TO NOTE REFERENCE IN TEXT

It can do this every time it builds: (Mortimer et al., 2016) GO TO NOTE REFERENCE IN TEXT
Zoologist Takeshi Watanabe showed: (Watanabe, 1999, 2000) GO TO NOTE REFERENCE IN TEXT
Orb-weavers will also: (Nakata, 2010, 2013)

GO TO NOTE REFERENCE IN TEXT

The web, then, is not just: A great review of spiderwebs as examples of extended cognition is Japyassú and Laland (2017).

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Biophysicist Natasha Mhatre showed that: (Mhatre, Sivalinghem, and Mason, 2018) GO TO NOTE REFERENCE IN TEXT

CHAPTER 8

To test this idea: Payne's account of his own work on barn owls is Payne (1971).

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Over the next four years: (Payne, 1971)

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If a mouse rustles: (Dusenbery, 1992)

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The barn owl's ear: (Konishi, 1973, 2012)

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Their hair cells regenerate: (Krumm et al., 2017)

GO TO NOTE REFERENCE IN TEXT

Masakazu Konishi and Eric Knudsen: (Knudsen, Blasdel, and Konishi, 1979) GO TO NOTE REFERENCE IN TEXT
An owl's ears, however: (Payne, 1971)

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The owl's brain uses: (Carr and Christensen-Dalsgaard, 2015, 2016) GO TO NOTE REFERENCE IN TEXT
William Stebbins once encapsulated this beautifully: An old but good review of animal hearing is Stebbins (1983). The quote is from page 1.

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Fortunately, the owl has soft feathers: (Weger and Wagner, 2016; Clark, LePiane, and Liu, 2020) GO TO NOTE REFERENCE IN TEXT
The noise it does make: (Konishi, 2012)

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These little hopping rodents: (Webster and Webster, 1980) GO TO NOTE REFERENCE IN TEXT
So they're especially difficult: (Webster, 1962; Stangl et al., 2005) GO TO NOTE REFERENCE IN TEXT

They can even hear the sounds: (Webster and Webster, 1971) GO TO NOTE REFERENCE IN TEXT
They have also evolved ears: Insect ears are reviewed in Fullard and Yack (1993); Göpfert and Hennig (2016).

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After all, the first insects: (Göpfert and Hennig, 2016)

GO TO NOTE REFERENCE IN TEXT

They had to evolve ears: (Robert, Mhatre, and McDonagh, 2010) GO TO NOTE REFERENCE IN TEXT
Ears exist on the knees: (Göpfert, Surlykke, and Wasserthal, 2002; Montealegre-Z et al., 2012) GO TO NOTE REFERENCE IN TEXT
Mosquitoes hear with their antennae: (Menda et al., 2019) GO TO NOTE REFERENCE IN TEXT
Monarch caterpillars hear: (Taylor and Yack, 2019)

GO TO NOTE REFERENCE IN TEXT

The bladder grasshopper: (Yager and Hoy, 1986; Van Staaden et al., 2003) GO TO NOTE REFERENCE IN TEXT
“In later years some further ears”: (Pye, 2004)

GO TO NOTE REFERENCE IN TEXT

Insect ears are so diverse: (Fullard and Yack, 1993)

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Accordingly, many insects seem: (Strauß and Stumpner, 2015) GO TO NOTE REFERENCE IN TEXT
Many butterflies, including: (Lane, Lucas, and Yack, 2008) GO TO NOTE REFERENCE IN TEXT
Instead, Jayne Yack has shown: (Fournier et al., 2013)

GO TO NOTE REFERENCE IN TEXT

Fossilized insects that have: (Gu et al., 2012)

GO TO NOTE REFERENCE IN TEXT

But Daniel Robert is so familiar: (Robert, Amoroso, and Hoy, 1992) GO TO NOTE REFERENCE IN TEXT

It can turn toward a singing cricket: (Mason, Oshinsky, and Hoy, 2001; Müller and Robert, 2002) GO TO NOTE REFERENCE IN TEXT
But Robert and his mentor: (Miles, Robert, and Hoy, 1995) GO TO NOTE REFERENCE IN TEXT
Through several painstaking studies, Barbara Webb: (Webb, 1996) GO TO NOTE REFERENCE IN TEXT
Webb even built a simple robot: (Webb, 1996)

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This happened within 20 generations: (Zuk, Rotenberry, and Tinghitella, 2006; Schneider et al., 2018) GO TO NOTE REFERENCE IN TEXT
the túngara frog: (Ryan, 1980)

GO TO NOTE REFERENCE IN TEXT

Ryan knows this because he spent: (Ryan, 1980)

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Females almost always go for males: (Ryan et al., 1990)

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Ryan found that the frog's inner ear: (Ryan and Rand, 1993) GO TO NOTE REFERENCE IN TEXT
Ryan discovered the actual story: (Ryan and Rand, 1993)

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This discovery flipped Ryan's narrative: (Ryan and Rand, 1993) GO TO NOTE REFERENCE IN TEXT
Ryan calls this phenomenon "sensory exploitation": His account of his work on túngara frogs is Ryan (2018).

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But Alexandra Basolo found: (Basolo, 1990)

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Tuttle and Ryan showed: (Tuttle and Ryan, 1981)

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One of Ryan's students, Rachel Page: (Page and Ryan, 2008) GO TO NOTE REFERENCE IN TEXT
Another of Ryan's students, Ximena Bernal: (Bernal, Rand, and Ryan, 2006) GO TO NOTE REFERENCE IN TEXT
Bird enthusiasts have long suspected: Bird hearing is reviewed in Dooling and Prior (2017).

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A mockingbird doesn't need: (Birkhead, 2013)

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In the 1960s, before his work: (Konishi, 1969)

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From the 1970s onward: (Dooling, Lohr, and Dent, 2000)

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Dooling confirmed this through: (Dooling et al., 2002)

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When Beth Vernaleo: (Vernaleo and Dooling, 2011)

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They completely shuffled the order: (Lawson et al., 2018) GO TO NOTE REFERENCE IN TEXT
A zebra finch's song: (Dooling and Prior, 2017)

GO TO NOTE REFERENCE IN TEXT

Not all species: (Fishbein et al., 2020)

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But Dooling's colleague Nora Prior: (Prior et al., 2018)

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He and his colleagues placed electrodes: (Lucas et al., 2002) GO TO NOTE REFERENCE IN TEXT

Likewise, ears can have exceptional: (Henry et al., 2011) GO TO NOTE REFERENCE IN TEXT
Lucas found that in the fall: (Lucas et al., 2007)

GO TO NOTE REFERENCE IN TEXT

The hearing of the white-breasted nuthatch: (Lucas et al., 2007) GO TO NOTE REFERENCE IN TEXT
This might explain why: (Noirot et al., 2009)

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Lucas and his colleague Megan Gall: (Gall, Salameh, and Lucas, 2013) GO TO NOTE REFERENCE IN TEXT
It might get duller with age: (Caras, 2013)

GO TO NOTE REFERENCE IN TEXT

Males of the plainfin midshipman fish: (Sisneros, 2009)

GO TO NOTE REFERENCE IN TEXT

Green tree frogs: (Gall and Wilczynski, 2015)

GO TO NOTE REFERENCE IN TEXT

In the 1960s: (Kwon, 2019)

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One, based on recordings that Payne: (Payne and McVay, 1971) GO TO NOTE REFERENCE IN TEXT
The second showed that fin whales: (Payne and Webb, 1971) GO TO NOTE REFERENCE IN TEXT
The actual source only became clear: (Schevill, Watkins, and Backus, 1964) GO TO NOTE REFERENCE IN TEXT
Below those frequencies: (Narins, Stoeger, and O'Connell-Rodwell, 2016) GO TO NOTE REFERENCE IN TEXT
Knowing that fin whales: (Payne and Webb, 1971)

GO TO NOTE REFERENCE IN TEXT

Amid the spectrograms: (Clark and Gagnon, 2004)

GO TO NOTE REFERENCE IN TEXT

On his first day, Clark: (Costa, 1993)

GO TO NOTE REFERENCE IN TEXT

Geophysicists can certainly use: (Kuna and Nábělek, 2021) GO TO NOTE REFERENCE IN TEXT
He also suspects that the animals: (Tyack and Clark, 2000) GO TO NOTE REFERENCE IN TEXT
That might seem preposterous: (Goldbogen et al., 2019)

GO TO NOTE REFERENCE IN TEXT

Those ancestral creatures: (Mourlam and Orliac, 2017)

GO TO NOTE REFERENCE IN TEXT

The mysticetes achieved their huge size: (Shadwick, Potvin, and Goldbogen, 2019) GO TO NOTE REFERENCE IN TEXT
In May 1984, Katy Payne: Her account of her own elephant research is Payne (1999).

GO TO NOTE REFERENCE IN TEXT

“It had been like the feeling”: (Payne, 1999, p. 20)

GO TO NOTE REFERENCE IN TEXT

But when Payne sped up the recordings: (Payne, Langbauer, and Thomas, 1986) GO TO NOTE REFERENCE IN TEXT
She accepted, and in 1986: (Poole et al., 1988)

GO TO NOTE REFERENCE IN TEXT

At close range: (Poole et al., 1988)

GO TO NOTE REFERENCE IN TEXT

A few hours after sunset: (Garstang et al., 1995)

GO TO NOTE REFERENCE IN TEXT

Her work strongly suggests: (Ketten, 1997)

GO TO NOTE REFERENCE IN TEXT

These superlatively big animals: (Miles, Robert, and Hoy, 1995) GO TO NOTE REFERENCE IN TEXT
In the winter of 1877: (Sidebotham, 1877)

GO TO NOTE REFERENCE IN TEXT

Roughly a century later: (Noirot, 1966; Zippelius, 1974; Sales, 2010) GO TO NOTE REFERENCE IN TEXT
Pups that are separated: (Sewell, 1970)

GO TO NOTE REFERENCE IN TEXT

Rats that are tickled: (Panksepp and Burgdorf, 2000)

GO TO NOTE REFERENCE IN TEXT

Richardson's ground squirrels: (Wilson and Hare, 2004)

GO TO NOTE REFERENCE IN TEXT

Male mice that sniff: (Holy and Guo, 2005)

GO TO NOTE REFERENCE IN TEXT

Females attracted to these serenades: (Neunuebel et al., 2015) GO TO NOTE REFERENCE IN TEXT
It refers to sound waves: A review of ultrasonic communication is Arch and Narins (2008).

GO TO NOTE REFERENCE IN TEXT

A dog can hear 45 kHz: (Heffner, 1983; Heffner and Heffner, 1985, 2018; Kojima, 1990; Ridgway and Au, 2009; Reynolds et al., 2010) GO TO NOTE REFERENCE IN TEXT
Rickye and Henry Heffner: (Heffner and Heffner, 2018)

GO TO NOTE REFERENCE IN TEXT

Subterranean animals are a striking exception: (Heffner and Heffner, 2018) GO TO NOTE REFERENCE IN TEXT
This means that ultrasonic calls: (Arch and Narins, 2008) GO TO NOTE REFERENCE IN TEXT
This is also why devices: (Aflitto and DeGomez, 2014)

GO TO NOTE REFERENCE IN TEXT

That's what Marissa Ramsier noticed: (Ramsier et al., 2012) GO TO NOTE REFERENCE IN TEXT
The blue-throated hummingbird: (Pytte, Ficken, and Moiseff, 2004) GO TO NOTE REFERENCE IN TEXT
Several other hummingbirds: (Olson et al., 2018)

GO TO NOTE REFERENCE IN TEXT

This orange frog is: insensitive: (Goutte et al., 2017)

GO TO NOTE REFERENCE IN TEXT

More than half of the 160,000 species: The battle between insects and bats is reviewed in Conner and Corcoran (2012).

GO TO NOTE REFERENCE IN TEXT

The greater wax moth: (Moir, Jackson, and Windmill, 2013) GO TO NOTE REFERENCE IN TEXT
Some moths do make ultrasonic: (Nakano et al., 2009, 2010) GO TO NOTE REFERENCE IN TEXT
The most likely answer: (Kawahara et al., 2019)

GO TO NOTE REFERENCE IN TEXT

Moth ears almost always evolved: (Kawahara et al., 2019)

GO TO NOTE REFERENCE IN TEXT

CHAPTER 9

By listening for the returning echoes: Echolocation is thoroughly reviewed in Surlykke et al. (2014).

GO TO NOTE REFERENCE IN TEXT

During the day, sharp-eyed predators: (Boonman et al., 2013) GO TO NOTE REFERENCE IN TEXT
It's actually the other way round: (Kalka, Smith, and Kalko, 2008) GO TO NOTE REFERENCE IN TEXT
In the 1790s, the Italian priest: The history of echolocation research is reviewed in Griffin (1974); Grinnell, Gould, and Fenton (2016).

GO TO NOTE REFERENCE IN TEXT

The meaning of these observations: Donald Griffin's classic work on echolocation and his research is Griffin (1974).

GO TO NOTE REFERENCE IN TEXT

For over a century: (Griffin, 1974)

GO TO NOTE REFERENCE IN TEXT

"We were surprised and delighted": (Griffin, 1974, p. 67) GO TO NOTE REFERENCE IN TEXT
A year later, Griffin: (Griffin and Galambos, 1941; Galambos and Griffin, 1942) GO TO NOTE REFERENCE IN TEXT
But the duo did mean it: (Griffin, 1944a)

GO TO NOTE REFERENCE IN TEXT

Sitting by a pond near Ithaca: (Griffin, 1953)

GO TO NOTE REFERENCE IN TEXT

It's also how bats hunt: (Griffin, Webster, and Michael, 1960) GO TO NOTE REFERENCE IN TEXT
"Our scientific imaginations": (Griffin, 2001)

GO TO NOTE REFERENCE IN TEXT

The origins of echolocation: (Jones and Teeling, 2006)

GO TO NOTE REFERENCE IN TEXT

The basic process seems straightforward: (Schnitzler and Kalko, 2001; Fenton et al., 2016; Moss, 2018) GO TO NOTE REFERENCE IN TEXT
An average bat can only: (Surlykke and Kalko, 2008)

GO TO NOTE REFERENCE IN TEXT

Anything farther away is probably imperceptible: (Holderied and von Helversen, 2003) GO TO NOTE REFERENCE IN TEXT
That's because bats concentrate: (Jakobsen, Ratcliffe, and Surlykke, 2013) GO TO NOTE REFERENCE IN TEXT
The big brown bat: (Ghose, Moss, and Horiuchi, 2007)

GO TO NOTE REFERENCE IN TEXT

Annemarie Surlykke showed that: (Hulgard et al., 2016)

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Even the so-called whispering bats: (Brinkløv, Kalko, and Surlykke, 2009) GO TO NOTE REFERENCE IN TEXT
This desensitizes their hearing: (Henson, 1965; Suga and Schlegel, 1972) GO TO NOTE REFERENCE IN TEXT
This is called acoustic gain control: (Kick and Simmons, 1984) GO TO NOTE REFERENCE IN TEXT
John Ratcliffe showed that: (Elemans et al., 2011; Ratcliffe et al., 2013) GO TO NOTE REFERENCE IN TEXT
And as James Simmons: (Simmons, Ferragamo, and Moss, 1998) GO TO NOTE REFERENCE IN TEXT
All of these frequencies: (Simmons and Stein, 1980; Moss and Schnitzler, 1995) GO TO NOTE REFERENCE IN TEXT
It knows the insect's position: (Zagaeski and Moss, 1994) GO TO NOTE REFERENCE IN TEXT
A bat must constantly adjust its sonar: (Moss and Surlykke, 2010; Moss, Chiu, and Surlykke, 2011) GO TO NOTE REFERENCE IN TEXT
Bats can race through rugged caves: (Grinnell and Griffin, 1958) GO TO NOTE REFERENCE IN TEXT
These messy spaces pose special problems: (Surlykke, Simmons, and Moss, 2016) GO TO NOTE REFERENCE IN TEXT
She also found that: (Chiu, Xian, and Moss, 2009)

GO TO NOTE REFERENCE IN TEXT

They also tend to group their calls: (Moss et al., 2006; Kothari et al., 2014) GO TO NOTE REFERENCE IN TEXT

The chestnut sac-winged bat: (Jung, Kalko, and von Helversen, 2007) GO TO NOTE REFERENCE IN TEXT
Inga Geipel found that the bat: (Geipel, Jung, and Kalko, 2013; Geipel et al., 2019) GO TO NOTE REFERENCE IN TEXT
Big browns do this by: (Chiu and Moss, 2008; Chiu, Xian, and Moss, 2008) GO TO NOTE REFERENCE IN TEXT
Some bats can recognize the sonar: (Yovel et al., 2009)

GO TO NOTE REFERENCE IN TEXT

The greater bulldog bat: (Suthers, 1967)

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Researchers have called this the "cocktail party nightmare": (Ulanovsky and Moss, 2008; Corcoran and Moss, 2017) GO TO NOTE REFERENCE IN TEXT
This explains the many historical incidents: (Griffin, 1974)

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an entire section to "bumbling bats": (Griffin, 1974, p. 160) GO TO NOTE REFERENCE IN TEXT
They can distinguish two grades of sandpaper: (Zagaeski and Moss, 1994) GO TO NOTE REFERENCE IN TEXT
But around 160 species: (Schnitzler and Denzinger, 2011; Fenton, Faure, and Ratcliffe, 2012) GO TO NOTE REFERENCE IN TEXT
Hans-Ulrich Schnitzler, who: (Kober and Schnitzler, 1990; von der Emde and Schnitzler, 1990; Koselj, Schnitzler, and Siemers, 2011) GO TO NOTE REFERENCE IN TEXT
The greater horseshoe bat: (Schuller and Pollak, 1979; Schnitzler and Denzinger, 2011) GO TO NOTE REFERENCE IN TEXT
Other species have their own signature: (Grinnell, 1966; Schuller and Pollak, 1979) GO TO NOTE REFERENCE IN TEXT
But as Schnitzler discovered in 1967: (Schnitzler, 1967)

GO TO NOTE REFERENCE IN TEXT

And they do this (quite literally): (Schnitzler, 1973)

GO TO NOTE REFERENCE IN TEXT

A horseshoe bat can throw its attention: (Hiryu et al., 2005) GO TO NOTE REFERENCE IN TEXT

When not inflaming the airways: (Ntelezos, Guarato, and Windmill, 2016; Neil et al., 2020) GO TO NOTE REFERENCE IN TEXT
This acoustic armor: (Conner and Corcoran, 2012)

GO TO NOTE REFERENCE IN TEXT

So while bats can hear: (Surlykke and Kalko, 2008)

GO TO NOTE REFERENCE IN TEXT

Others talk back: (Dunning and Roeder, 1965)

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Dorothy Dunning and Kenneth Roeder: (Dunning and Roeder, 1965) GO TO NOTE REFERENCE IN TEXT
Many tiger moths are full: (Barber and Conner, 2007)

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In 2009, Aaron Corcoran: (Corcoran, Barber, and Conner, 2009) GO TO NOTE REFERENCE IN TEXT
The clicks overlapped: (Corcoran et al., 2011)

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But unlike the tiger moths: (Barber and Kawahara, 2013)

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With their stealthy whispers: (Goerlitz et al., 2010; ter Hofstede and Ratcliffe, 2016) GO TO NOTE REFERENCE IN TEXT
On average, a luna moth: (Barber et al., 2015)

GO TO NOTE REFERENCE IN TEXT

Moths have evolved long tails: (Rubin et al., 2018)

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Donald Griffin once described: (Griffin, 2001)

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Both groups did so by evolving echolocation: Echolocation in whales and bats is compared in Au and Simmons (2007); Surlykke et al. (2014).

GO TO NOTE REFERENCE IN TEXT

After watching porpoises: (Schevill and McBride, 1956)

GO TO NOTE REFERENCE IN TEXT

Ken Norris carried out: (Norris et al., 1961)

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So researchers who study dolphins: Dolphin echolocation research is reviewed in Au (2011); Nachtigall (2016).

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A field station in Hawaii's: Whitlow Au's seminal work on dolphin sonar is Au (1993).

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At Kāne'ohe Bay, where bottlenose dolphins: (Au, 1993) GO TO NOTE REFERENCE IN TEXT
Dolphins could discriminate between different objects: (Au and Turl, 1983)

GO TO NOTE REFERENCE IN TEXT

The animal, Kina, could use: (Brill et al., 1992)

GO TO NOTE REFERENCE IN TEXT

Dolphins can also echolocate on: (Pack and Herman, 1995; Harley, Roitblat, and Nachtigall, 1996) GO TO NOTE REFERENCE IN TEXT
At the top of the dolphin's head: (Cranford, Amundin, and Norris, 1996) GO TO NOTE REFERENCE IN TEXT
The sperm whale: (Madsen et al., 2002)

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At 236 decibels: (Møhl et al., 2003)

GO TO NOTE REFERENCE IN TEXT

Odontocetes also intercept their own echoes: (Mooney, Yamato, and Branstetter, 2012) GO TO NOTE REFERENCE IN TEXT
When they need more information: (Finneran, 2013)

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They can adjust the sensitivity: (Nachtigall and Supin, 2008) GO TO NOTE REFERENCE IN TEXT
In an early experiment, Au showed: (Au, 1993)

GO TO NOTE REFERENCE IN TEXT

Later studies showed that echolocating dolphins: (Ivanov, 2004; Finneran, 2013) GO TO NOTE REFERENCE IN TEXT
Sound also interacts differently: (Madsen and Surlykke, 2014) GO TO NOTE REFERENCE IN TEXT
If a dolphin echolocates on you: (Au, 1996)

GO TO NOTE REFERENCE IN TEXT

It can pick out the air-filled swim bladders: (Au et al., 2009) GO TO NOTE REFERENCE IN TEXT
The American shad: (Popper et al., 2004)

GO TO NOTE REFERENCE IN TEXT

Pavel Gol'din has suggested: (Gol'din, 2014)

GO TO NOTE REFERENCE IN TEXT

But despite their rarity: (Tyack, 1997; Tyack and Clark, 2000) GO TO NOTE REFERENCE IN TEXT
One way to find out: (Johnson, Aguilar de Soto, and Madsen, 2009) GO TO NOTE REFERENCE IN TEXT
Since 2003, one team of researchers: (Johnson et al., 2004; Arranz et al., 2011; Madsen et al., 2013) GO TO NOTE REFERENCE IN TEXT
Kelly Benoit-Bird and Whitlow Au showed: (Benoit-Bird and Au, 2009a, 2009b) GO TO NOTE REFERENCE IN TEXT
When Daniel Kish clicks: (Thaler et al., 2017)

GO TO NOTE REFERENCE IN TEXT

Now in his 50s, Kish: (Kish, 2015)

GO TO NOTE REFERENCE IN TEXT

Small mammals might make ultrasonic: clicks: (Gould, 1965; Eisenberg and Gould, 1966; Siemers et al., 2009) GO TO NOTE REFERENCE IN TEXT
Certain fruit bats: (Boonman, Bumrungsri, and Yovel, 2014) GO TO NOTE REFERENCE IN TEXT
The oilbird, a large South American: (Brinkløv and Warrant, 2017; Brinkløv, Elemans, and Ratcliffe, 2017) GO TO NOTE REFERENCE IN TEXT
Swiftlets, small insect-eating birds: (Brinkløv, Fenton, and Ratcliffe, 2013) GO TO NOTE REFERENCE IN TEXT
And as Kish and: (Thaler and Goodale, 2016)

GO TO NOTE REFERENCE IN TEXT

Why don’t seals echolocate?: (Schusterman et al., 2000)

GO TO NOTE REFERENCE IN TEXT

Since at least 1749: (Diderot, 1749; Supa, Cotzin, and Dallenbach, 1944; Kish, 1995) GO TO NOTE REFERENCE IN TEXT
In the 1940s: (Supa, Cotzin, and Dallenbach, 1944)

GO TO NOTE REFERENCE IN TEXT

Supa referenced the bat studies: (Griffin, 1944a)

GO TO NOTE REFERENCE IN TEXT

Neuroscientist Lore Thaler: (Thaler, Arnott, and Goodale, 2011) GO TO NOTE REFERENCE IN TEXT
Without vision, the brain: (Norman and Thaler, 2019)

GO TO NOTE REFERENCE IN TEXT

His memory, his cane: (Thaler et al., 2020)

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CHAPTER 10

Around 350 species of fish: For primers on electric fish, see Hopkins (2009); Carlson et al. (2019).

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Around 5,000 years ago: For a history of electric fish, see Wu (1984); Zupanc and Bullock (2005); Carlson and Sisneros (2019).

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For a fuller account, try: (Finger and Piccolino, 2011)

GO TO NOTE REFERENCE IN TEXT

None do this better than electric eels: (Catania, 2019)

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In 1800, Chayma fishers: (Catania, 2016)

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And a team led by: (de Santana et al., 2019)

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Their discharges are so faint: (Hopkins, 2009)

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“It is impossible to conceive”: (Darwin, 1958, p. 178)

GO TO NOTE REFERENCE IN TEXT

Hans Lissmann was a Ukrainian-born: Lissmann’s eventful life is detailed in Alexander (1996).

GO TO NOTE REFERENCE IN TEXT

During a fateful visit: (Turkel, 2013)

GO TO NOTE REFERENCE IN TEXT

In 1951, Lissmann used electrodes: (Lissmann, 1951)

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And by sensing those distortions: (Lissmann, 1958)

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Lissmann and Machin published their results: (Lissmann and Machin, 1958) GO TO NOTE REFERENCE IN TEXT
The fish can detect these differences: Good reviews on active electrolocation include Lewis (2014); Caputi (2017).

GO TO NOTE REFERENCE IN TEXT

The black ghost knifefish: (von der Emde, 1990, 1999; von der Emde et al., 1998; Snyder et al., 2007) GO TO NOTE REFERENCE IN TEXT
“A most interesting consequence”: (Hopkins, 2009)

GO TO NOTE REFERENCE IN TEXT

It is also omnidirectional: (Snyder et al., 2007)

GO TO NOTE REFERENCE IN TEXT

To double the range: (Salazar, Krahe, and Lewis, 2013)

GO TO NOTE REFERENCE IN TEXT

Elephantfish eyes seem to be tuned: (von der Emde and Ruhl, 2016) GO TO NOTE REFERENCE IN TEXT
The omnidirectional nature of electrolocation: (Caputi et al., 2013) GO TO NOTE REFERENCE IN TEXT
They’ll wrap their bodies: (Caputi, Aguilera, and Pereira, 2011) GO TO NOTE REFERENCE IN TEXT
Angel Caputi has argued: (Caputi et al., 2013)

GO TO NOTE REFERENCE IN TEXT

The electric sense *evolved from:* (Baker, 2019) GO TO NOTE REFERENCE IN TEXT
Electroreceptors grow from the same: (Modrell et al., 2011; Baker, Modrell, and Gillis, 2013) GO TO NOTE REFERENCE IN TEXT
Electric fields aren’t blocked by barriers: (Lewis, 2014) GO TO NOTE REFERENCE IN TEXT
They are sensitive not only to conductance: (von der Emde, 1990) GO TO NOTE REFERENCE IN TEXT

For decades, scientists have studied: (Carlson and Sisneros, 2019) GO TO NOTE REFERENCE IN TEXT
But the animals' actual worlds: For some of the challenges of field research, see Hagedorn (2004).

GO TO NOTE REFERENCE IN TEXT

Such electrodes have improved over time: (Henninger et al., 2018; Madhav et al., 2018) GO TO NOTE REFERENCE IN TEXT
They court mates, claim territory: For more on electrocommunication, see Zupanc and Bullock (2005); Baker and Carlson (2019).

GO TO NOTE REFERENCE IN TEXT

The shape of these pulses: (Hopkins, 1981; McGregor and Westby, 1992; Carlson, 2002) GO TO NOTE REFERENCE IN TEXT
One rhythm might be as attractive: (Hopkins and Bass, 1981) GO TO NOTE REFERENCE IN TEXT
The neuroscientist Ted Bullock: (Bullock, Behrend, and Heiligenberg, 1975) GO TO NOTE REFERENCE IN TEXT
In *Sensory Exotica:* (Hughes, 2001) GO TO NOTE REFERENCE IN TEXT
By minutely changing the frequencies: (Bullock, 1969)

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By briefly and sharply increasing: (Hagedorn and Heiligenberg, 1985) GO TO NOTE REFERENCE IN TEXT
If two *Eigenmannia* meet: (Bullock, Behrend, and Heiligenberg, 1975) GO TO NOTE REFERENCE IN TEXT
The mormyrins have altered: (Carlson and Arnegard, 2011; Vélez, Ryoo, and Carlson, 2018) GO TO NOTE REFERENCE IN TEXT
Carlson suspects that these changes: (Baker, Huck, and Carlson, 2015) GO TO NOTE REFERENCE IN TEXT
One species, the Ubangi elephantfish: (Nilsson, 1996; Sukhum et al., 2016) GO TO NOTE REFERENCE IN TEXT
Carlson has shown that one mormyrid: (Arnegard and Carlson, 2005) GO TO NOTE REFERENCE IN TEXT
They probe the sandy floor: (Amey-Özel et al., 2015)

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In 1960, biologist R. W. Murray: (Murray, 1960)

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A few years later, Sven Dijkgraaf: (Dijkgraaf and Kalmijn, 1962) GO TO NOTE REFERENCE IN TEXT
The jelly inside the ampullae: (Josberger et al., 2016)

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It turns out that *all* living things: (Kalmijn, 1974) GO TO NOTE REFERENCE IN TEXT
These fields are thousands of times: (Kalmijn, 1974; Bedore and Kajiura, 2013) GO TO NOTE REFERENCE IN TEXT
Kalmijn proved as much in 1971: (Kalmijn, 1971)

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Wild sharks will also bite: (Kalmijn, 1982)

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Some do so from birth: (Kajiura, 2003)

GO TO NOTE REFERENCE IN TEXT

The shark's electric sense: For reviews on passive electroreception, see Hopkins (2005, 2009).

GO TO NOTE REFERENCE IN TEXT

Some stingrays use electric fields: (Tricas, Michael, and Sisneros, 1995) GO TO NOTE REFERENCE IN TEXT
And some embryonic sharks: (Kempster, Hart, and Collin, 2013) GO TO NOTE REFERENCE IN TEXT
A shark's electric sense only works: (Kajiura and Holland, 2002) GO TO NOTE REFERENCE IN TEXT
Over mile distances, a shark: (Gardiner et al., 2014)

GO TO NOTE REFERENCE IN TEXT

It's also why electric fields trigger: (Dijkgraaf and Kalmijn, 1962) GO TO NOTE REFERENCE IN TEXT
When cuttlefish see the looming shapes: (Bedore, Kajiura, and Johnsen, 2015) GO TO NOTE REFERENCE IN TEXT
Instead of conical snouts, hammerhead sharks: (Kajiura, 2001) GO TO NOTE REFERENCE IN TEXT
It greatly extends the sawfish's: (Wueringer, Squire, et al., 2012a) GO TO NOTE REFERENCE IN TEXT

She showed that the saw: (Wueringer, Squire, et al., 2012b) GO TO NOTE REFERENCE IN TEXT
Wueringer founded an organization: (Wueringer, 2012)

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The ability to detect electric fields: Electroreception is reviewed in Collin (2019); Crampton (2019).

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Among vertebrates, around one in six: (Albert and Crampton, 2006) GO TO NOTE REFERENCE IN TEXT
At least one species of dolphin: (Czech-Damal et al., 2012) GO TO NOTE REFERENCE IN TEXT
Similarly, it's unclear how the echidnas: (Gregory et al., 1989) GO TO NOTE REFERENCE IN TEXT
Their close relative, the platypus: (Pettigrew, Manger, and Fine, 1998; Proske and Gregory, 2003) GO TO NOTE REFERENCE IN TEXT
This extensive cabal of electroreceptive critters: (Baker, Modrell, and Gillis, 2013) GO TO NOTE REFERENCE IN TEXT
The knifefishes and elephantfishes are special cases: (Lavoué et al., 2012) GO TO NOTE REFERENCE IN TEXT
These events happened at roughly: (Lavoué et al., 2012)

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Air, by contrast, is an insulator: (Czech-Damal et al., 2013) GO TO NOTE REFERENCE IN TEXT
This is the atmospheric potential gradient: (Feynman, 1964) GO TO NOTE REFERENCE IN TEXT
Attracted by their opposing charges: (Corbet, Beament, and Eisikowitch, 1982; Vaknin et al., 2000) GO TO NOTE REFERENCE IN TEXT
In 2013, Robert and his colleagues: (Clarke et al., 2013) GO TO NOTE REFERENCE IN TEXT
The bees also learned to more quickly: (Clarke et al., 2013) GO TO NOTE REFERENCE IN TEXT
Instead, their electroreceptors are: (Sutton et al., 2016) GO TO NOTE REFERENCE IN TEXT
The mere possibility of widespread aerial electroreception: Aerial electroreception is reviewed in Clarke, Morley, and Robert (2017).

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In 2018, Robert's colleague Erica Morley: (Morley and Robert, 2018) GO TO NOTE REFERENCE IN TEXT
another scientist had suggested: that spiders: (Blackwall, 1830) GO TO NOTE REFERENCE IN TEXT
The rival won: It was resurrected in Gorham (2013).

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CHAPTER 11

Every spring, billions of bogongs: (Warrant et al., 2016) GO TO NOTE REFERENCE IN TEXT
Warrant realized that: (Dreyer et al., 2018)

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Their ability, known as magnetoreception: For reviews of magnetoreception, see Johnsen and Lohmann (2005); Mouritsen (2018).

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Merkel and his students: (Merkel and Fromme, 1958; Pollack, 2012) GO TO NOTE REFERENCE IN TEXT
In 1859, the zoologist: (Middendorff, 1855)

GO TO NOTE REFERENCE IN TEXT

Absent such proof, even Donald Griffin: (Griffin, 1944b)

GO TO NOTE REFERENCE IN TEXT

Merkel and Wiltschko provided that evidence: (Wiltschko and Merkel, 1965; Wiltschko, 1968) GO TO NOTE REFERENCE IN TEXT
At roughly the same time: (Brown, 1962; Brown, Webb, and Barnwell, 1964) GO TO NOTE REFERENCE IN TEXT
Earth's magnetic field: (Johnsen and Lohmann, 2005)

GO TO NOTE REFERENCE IN TEXT

Many scientists, including Wiltschko: (Wiltschko and Wiltschko, 2019) GO TO NOTE REFERENCE IN TEXT
Since Merkel's robins took: (Lohmann et al., 1995; Deutschlander, Borland, and Phillips, 1999; Sumner-Rooney et al., 2014; Scanlan et al., 2018) GO TO NOTE REFERENCE IN TEXT
After a busy night of insect-catching: (Holland et al., 2006) GO TO NOTE REFERENCE IN TEXT
After an early life: (Bottesch et al., 2016)

GO TO NOTE REFERENCE IN TEXT

Mole-rats use their compass: (Kimchi, Etienne, and Terkel, 2004) GO TO NOTE REFERENCE IN TEXT
And bogong moths: (Dreyer et al., 2018)

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To see if they do, Granger: (Granger et al., 2020)

GO TO NOTE REFERENCE IN TEXT

Robins can also be sent off course: (Bianco, Ilieva, and Åkesson, 2019) GO TO NOTE REFERENCE IN TEXT
Few migrations are as treacherous: A review of sea turtle migrations is Lohmann and Lohmann (2019).

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By the 1990s, no one: (Carr, 1995)

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As Lohmann suspected: (Lohmann, 1991)

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In the mid-1990s: (Lohmann and Lohmann, 1994, 1996)

GO TO NOTE REFERENCE IN TEXT

But each turtle species: (Lohmann, Putman, and Lohmann, 2008) GO TO NOTE REFERENCE IN TEXT
The turtles' abilities are especially impressive: (Lohmann et al., 2001) GO TO NOTE REFERENCE IN TEXT
Loggerheads that survive: (Lohmann et al., 2004)

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Lohmann demonstrated this by capturing lobsters: (Boles and Lohmann, 2003) GO TO NOTE REFERENCE IN TEXT
Every winter, thrush nightingales: (Fransson et al., 2001) GO TO NOTE REFERENCE IN TEXT
Eurasian reed warblers: (Chernetsov, Kishkinev, and Mouritsen, 2008) GO TO NOTE REFERENCE IN TEXT
Many animals, including salmon: (Putman et al., 2013; Wynn et al., 2020) GO TO NOTE REFERENCE IN TEXT
Turtles use these imprints: (Lohmann, Putman, and Lohmann, 2008) GO TO NOTE REFERENCE IN TEXT
Green turtles that nest on Ascension Island: (Mortimer and Portier, 1989) GO TO NOTE REFERENCE IN TEXT

The geomagnetic field changes very slightly: (Brothers and Lohmann, 2018) GO TO NOTE REFERENCE IN TEXT
Trying to find them: (Johnsen, 2017)

GO TO NOTE REFERENCE IN TEXT

At the time of writing: (Nordmann, Hochstoeger, and Keays, 2017) GO TO NOTE REFERENCE IN TEXT
The first involves a magnetic iron mineral: (Wiltschko and Wiltschko, 2013; Shaw et al., 2015) GO TO NOTE REFERENCE IN TEXT
In the 1970s, scientists discovered: (Blakemore, 1975)

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For decades, many scientists were sure: (Fleissner et al., 2003, 2007) GO TO NOTE REFERENCE IN TEXT
In 2012, Keays published a bombshell study: (Treiber et al., 2012) GO TO NOTE REFERENCE IN TEXT
That same year, another team: (Eder et al., 2012)

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But Keays debunked this finding: (Edelman et al., 2015)

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As a shark swims: (Paulin, 1995)

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The French zoologist Camille Viguier: (Viguier, 1882)

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Almost 130 years later, David Keays: (Nimpf et al., 2019) GO TO NOTE REFERENCE IN TEXT
It's also notable that, in 2011: (Wu and Dickman, 2012)

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It involves two molecules: A good review of the radical pair hypothesis is Hore and Mouritsen (2016).

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He submitted a paper: (Schulten, personal communication, 2010) GO TO NOTE REFERENCE IN TEXT
Undeterred, he published the paper: (Schulten, Swenberg, and Weller, 1978) GO TO NOTE REFERENCE IN TEXT
In 2000, Schulten and his student: (Ritz, Adem, and Schulten, 2000) GO TO NOTE REFERENCE IN TEXT
Known as cluster N: (Mouritsen et al., 2005)

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Cluster N gets information: (Heyers et al., 2007; Zapka et al., 2009) GO TO NOTE REFERENCE IN TEXT
One called Cry4: (Einwich et al., 2020; Hochstoeger et al., 2020) GO TO NOTE REFERENCE IN TEXT
And why, as Mouritsen showed: (Engels et al., 2014)

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A 1997 study claimed that honeybees: (Kirschvink et al., 1997) GO TO NOTE REFERENCE IN TEXT
Two decades later, another group: (Baltzley and Nabity, 2018) GO TO NOTE REFERENCE IN TEXT
In 1999, an American team: (Etheredge et al., 1999)

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In 2002, the Wiltschkos: (Wiltschko et al., 2002)

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A decade later, Henrik Mouritsen: (Hein et al., 2011; Engels et al., 2012) GO TO NOTE REFERENCE IN TEXT
In 2015, an American team: (Vidal-Gadea et al., 2015; Qin et al., 2016) GO TO NOTE REFERENCE IN TEXT
Neither study could be replicated: (Meister, 2016; Winklhofer and Mouritsen, 2016; Friis, Sjulstok, and Solov'yov, 2017; Landler et al., 2018) GO TO NOTE REFERENCE IN TEXT
Baker published his results: (Baker, 1980)

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More recently, geophysicist Joseph Kirschvink: (Wang et al., 2019) GO TO NOTE REFERENCE IN TEXT
They might tweak their experimental plans: A review of the many issues with irreproducible science is Aschwanden (2015).

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But Sonke Johnsen, Ken Lohmann: (Johnsen, Lohmann, and Warrant, 2020)
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Instead, they seem to use it: Magnetoreception and other means of animal navigation are reviewed in Mouritsen (2018).

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CHAPTER 12

Venkataraman tells me that the mosquitoes: The sensory cues that mosquitoes use to find their hosts are reviewed in Wolff and Riffell (2018).

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But it failed when Vosshall: (DeGennaro et al., 2013)

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Switching tactics, Vosshall's team tried: (McMeniman et al., 2014) GO TO NOTE REFERENCE IN TEXT
When Vosshall's student Molly Liu: (Liu and Vosshall, 2019) GO TO NOTE REFERENCE IN TEXT
After all, that's likely what DEET: (Dennis, Goldman, and Vosshall, 2019) GO TO NOTE REFERENCE IN TEXT
But thousands of years ago: (McBride et al., 2014; McBride, 2016) GO TO NOTE REFERENCE IN TEXT
Jumping spiders depend on: (Shamble et al., 2016)

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The star-nosed mole hunts: (Catania, 2006)

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Smell dominates the lives of ants: (Barbero et al., 2009) GO TO NOTE REFERENCE IN TEXT
Smells also guide sharks: (Gardiner et al., 2014)

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The Ubangi elephantnose fish: (von der Emde and Ruhl, 2016) GO TO NOTE REFERENCE IN TEXT
Songbirds and bogong moths: (Dreyer et al., 2018; Mouritsen, 2018) GO TO NOTE REFERENCE IN TEXT
Some people experience synesthesia: (Ward, 2013)

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The platypus's duck-like bill: (Pettigrew, Manger, and Fine, 1998) GO TO NOTE REFERENCE IN TEXT
"these probably fuse": (Wheeler, 1910, p. 510)

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Electric fish that learn: (Schumacher et al., 2016)

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Even bumblebees can tell: (Solvi, Gutierrez Al-Khudhairy, and Chittka, 2020) GO TO NOTE REFERENCE IN TEXT
There's proprioception, the awareness: Proprioception is reviewed in Tuthill and Azim (2018).

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In 1971, a 19-year-old butcher: (Cole, 2016)

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When animals move, their sense organs: The concepts of exafference, reafference, and corollary discharges are reviewed in Cullen (2004); Crapse and Sommer (2008).

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Consider a simple earthworm: (Merker, 2005)

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But no animals are completely immobile: (Ludeman et al., 2014) GO TO NOTE REFERENCE IN TEXT
Philosophers and scholars have speculated: For a full history of this idea, see Grüsser (1994).

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As of 1950, the duplicated motor commands: (von Holst and Mittelstaedt, 1950; Sperry, 1950) GO TO NOTE REFERENCE IN TEXT
For a full history: (Grüsser, 1994)

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Scientists have learned a lot: Corollary discharges in electric fish are reviewed in Sawtell (2017); Fukutomi and Carlson (2020).

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They're how chirping crickets: (Poulet and Hedwig, 2003)

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Some scientists have suggested that schizophrenia: (Pynn and DeSouza, 2013) GO TO NOTE REFERENCE IN TEXT
An octopus's central nervous system: The neurobiology of the octopus is reviewed in Grasso (2014); Levy and Hochner (2017).

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"An octopus effectively has nine brains": (Crook and Walters, 2014) GO TO NOTE REFERENCE IN TEXT
Meanwhile, it simultaneously touches and tastes: (Graziadei and Gagne, 1976) GO TO NOTE REFERENCE IN TEXT
The suckers' independence is obvious: (Nesher et al., 2014) GO TO NOTE REFERENCE IN TEXT
Between them, each sucker ganglion: (Grasso, 2014)

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For example, neurobiologist Binyamin Hochner: (Sumbre et al., 2006) GO TO NOTE REFERENCE IN TEXT
But Hochner's colleague Tamar Gutnick: (Gutnick et al., 2011) GO TO NOTE REFERENCE IN TEXT
Letizia Zullo, another member of Hochner's team: (Zullo et al., 2009; Hochner, 2013) GO TO NOTE REFERENCE IN TEXT
"a body of pure possibility": (Godfrey-Smith, 2016, p. 48) GO TO NOTE REFERENCE IN TEXT
Godfrey-Smith marvelously compares: (Godfrey-Smith, 2016, p. 105) GO TO NOTE REFERENCE IN TEXT
The octopus, then, arguably has *two:* (Grasso, 2014) GO TO NOTE REFERENCE IN TEXT

CHAPTER 13

We have instigated: The sixth extinction of wildlife is documented in Kolbert (2014); Ceballos, Ehrlich, and Dirzo (2017).

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Instead of stepping into the Umwelten: Sensory pollution is reviewed in Swaddle et al. (2015); Dominoni et al. (2020).

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Other, slow-moving species: (Spoelstra et al., 2017)

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A team of Dutch scientists: (D'Estries, 2019)

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In 2001, when astronomer Pierantonio Cinzano: (Cinzano, Falchi, and Elvidge, 2001) GO TO NOTE REFERENCE IN TEXT
In 2016, when the team updated: (Falchi et al., 2016)

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Every year, the proportion: (Kyba et al., 2017)

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"The thought of light": (Johnsen, 2012, p. 57)

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And by analyzing radar images: (Van Doren et al., 2017)

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In 1886, shortly after Edison: (Longcore and Rich, 2016)

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Over a century later, environmental scientist: (Longcore et al., 2012) GO TO NOTE REFERENCE IN TEXT
Many of these deaths: (Gehring, Kerlinger, and Manville, 2009) GO TO NOTE REFERENCE IN TEXT

Light at night: Light pollution and its effects on wildlife are reviewed in Sanders et al. (2021).

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In part, that's because biologists: (Gaston, 2019)

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When sea turtle hatchlings emerge: (Witherington and Martin, 2003) GO TO NOTE REFERENCE IN TEXT
Artificial lights can also fatally attract: (Owens et al., 2020) GO TO NOTE REFERENCE IN TEXT
A single streetlamp: (Degen et al., 2016)

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In 2014, as part of an experiment: (Knop et al., 2017)

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Insects with aquatic larvae: (Horváth et al., 2009)

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Flickering lightbulbs can cause headaches: (Inger et al., 2014) GO TO NOTE REFERENCE IN TEXT
The new generation of energy-efficient white LEDs: (Falchi et al., 2016; Longcore, 2018) GO TO NOTE REFERENCE IN TEXT
To protect them, the team first: (Buxton et al., 2017)

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Even the most heavily protected areas: Noise pollution and its effects are reviewed in Barber, Crooks, and Fristrup (2010); Shannon et al. (2016).

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Two-thirds of Europeans: (Swaddle et al., 2015)

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In 2003, Hans Slabbekoorn: (Slabbekoorn and Peet, 2003)

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A year later, Henrik Brumm: (Brumm, 2004)

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These influential studies spurred: (Leonard and Horn, 2008; Gross, Pasinelli, and Kunc, 2010; Montague, Danek-Gontard, and Kunc, 2013; Gil et al., 2015) GO TO NOTE REFERENCE IN TEXT
Every extra 3 decibels: (Francis et al., 2017)

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In 2012, Jesse Barber, Heidi Ware: (Ware et al., 2015)

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In one experiment, ladybird beetles: (Barton et al., 2018) GO TO NOTE REFERENCE IN TEXT
In noisy conditions, prairie dogs: (Shannon et al., 2014) GO TO NOTE REFERENCE IN TEXT
Owls flub their attacks: (Senzaki et al., 2016)

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Parasitic *Ormia* flies struggle: (Phillips et al., 2019) GO TO NOTE REFERENCE IN TEXT
Sage grouse abandon: (Blickley et al., 2012)

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In the summer of 2017: (Suraci et al., 2019)

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More than 83 percent: (Riitters and Wickham, 2003)

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Even the seas can't offer silence: Natural and anthropogenic noises in the ocean are reviewed in Duarte et al. (2021).

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War of the Whales: (Horwitz, 2015) GO TO NOTE REFERENCE IN TEXT
Either way, sonar clearly disturbs them: (DeRuiter et al., 2013; Miller, Kvadsheim, et al., 2015) GO TO NOTE REFERENCE IN TEXT

Between World War II and 2008: (Frisk, 2012)

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Since giant whales can live: (Payne and Webb, 1971)

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As ships pass in the night: (Rolland et al., 2012; Erbe, Dunlop, and Dolman, 2018; Tsujii et al., 2018; Erbe et al., 2019) GO TO NOTE REFERENCE IN TEXT
Crabs stop feeding: (Kunc et al., 2014; Simpson et al., 2016; Murchy et al., 2019) GO TO NOTE REFERENCE IN TEXT
“We’re conducting an experiment”: For more on shipping noise, see Hildebrand (2005); Malakoff (2010).

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Smooth vertical surfaces: (Greif et al., 2017)

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DMS, the seaweed-y chemical: (Wilcox, Van Sebille, and Hardesty, 2015; Savoca et al., 2016) GO TO NOTE REFERENCE IN TEXT
The currents produced by objects: (Rycyk et al., 2018)

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Odorants in river water: (Tierney et al., 2008)

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Weak electric fields: (Gill et al., 2014)

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Some urban moths: (Altermatt and Ebert, 2016)

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Some urban spiders: (Czaczkes et al., 2018)

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In the towns of Panama: (Halfwerk et al., 2019)

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That extraordinary diversity arose: (Seehausen et al., 2008) GO TO NOTE REFERENCE IN TEXT
By turning off the light: (Seehausen, van Alphen, and Witte, 1997) GO TO NOTE REFERENCE IN TEXT
Lake Victoria's cichlids also suffered: (Witte et al., 2013) GO TO NOTE REFERENCE IN TEXT
In 2020, science writer Maya Kapoor: (Kapoor, 2020)

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In the woodlands of New Mexico: (Francis et al., 2012)

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In 2016, marine biologist Tim Gordon: (Gordon et al., 2018, 2019) GO TO NOTE REFERENCE IN TEXT
Wire cages that are: (Irwin, Horner, and Lohmann, 2004)

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With fewer planes and cars: (Jechow and Hölker, 2020)

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Seismic vibrations around the world: (Lecocq et al., 2020) GO TO NOTE REFERENCE IN TEXT
Alaska's Glacier Bay: (Calma, 2020; Smith et al., 2020)

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Behavioral ecologist Elizabeth Derryberry: (Derryberry et al., 2020) GO TO NOTE REFERENCE IN TEXT
In the summer of 2007: (Stack et al., 2011)

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To truly make a dent: Ways of reducing sensory pollution are reviewed in Longcore and Rich (2016); Duarte et al. (2021).

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In 1995, environmental historian William Cronon: (Cronon, 1996) GO TO NOTE REFERENCE IN TEXT

In 1934, after considering: (Uexküll, 2010, p. 133)

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A B C D E F G H I J K L M N O P Q R S T U V
W X Y Z

BY ED YONG

I Contain Multitudes: The Microbes Within Us and a Grander View of Life

An Immense World: How Animal Senses Reveal the Hidden Realms Around Us

About the Author

ED YONG is an award-winning science writer on the staff of *The Atlantic,* where he won the Pulitzer Prize in Explanatory Reporting and the George Polk Award for Science Reporting, among other honors. His first book, *I Contain Multitudes,* was a *New York Times* bestseller and won numerous awards. His work has appeared in *The New Yorker, National Geographic, Wired, The New York Times, Scientific American,* and other publications. He lives in Washington, D.C.

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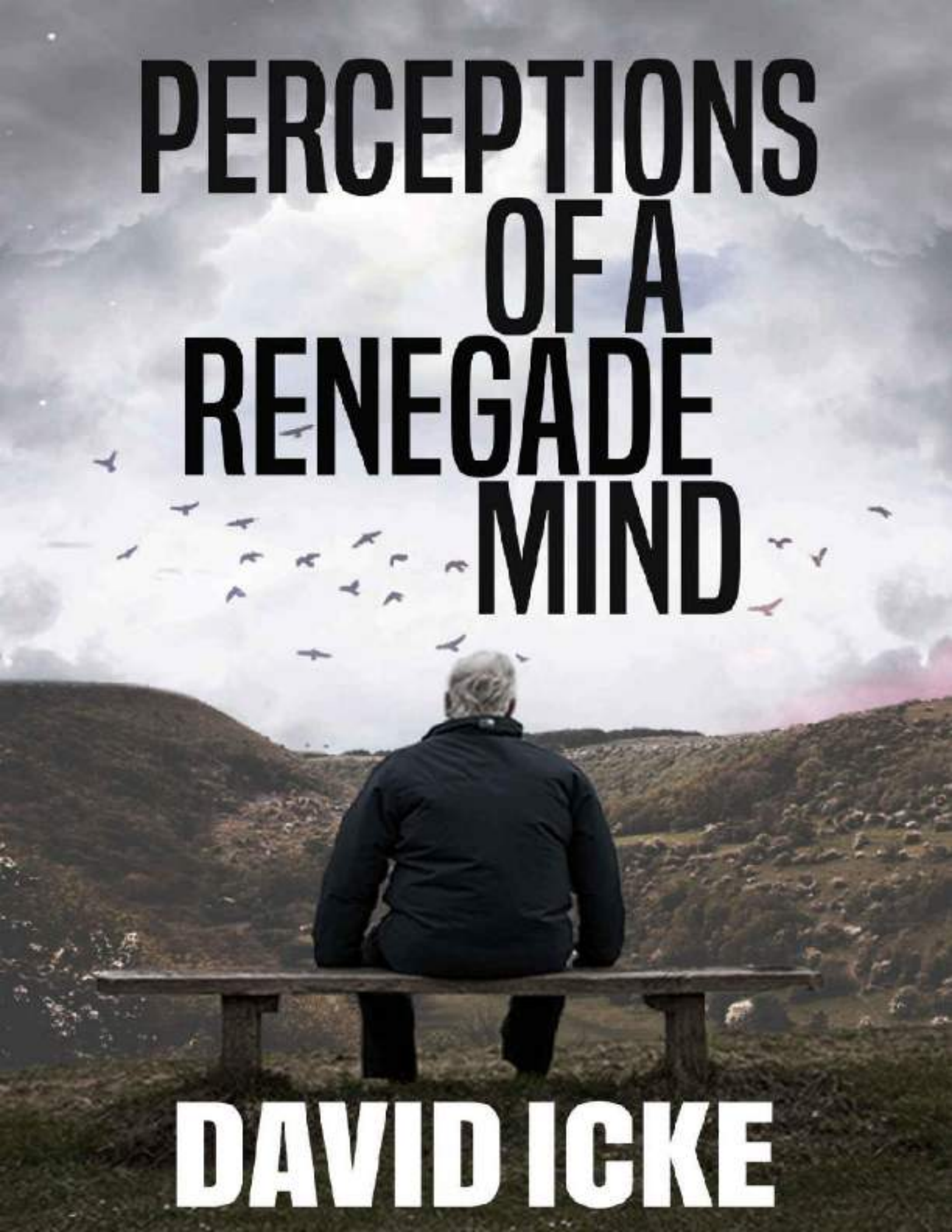

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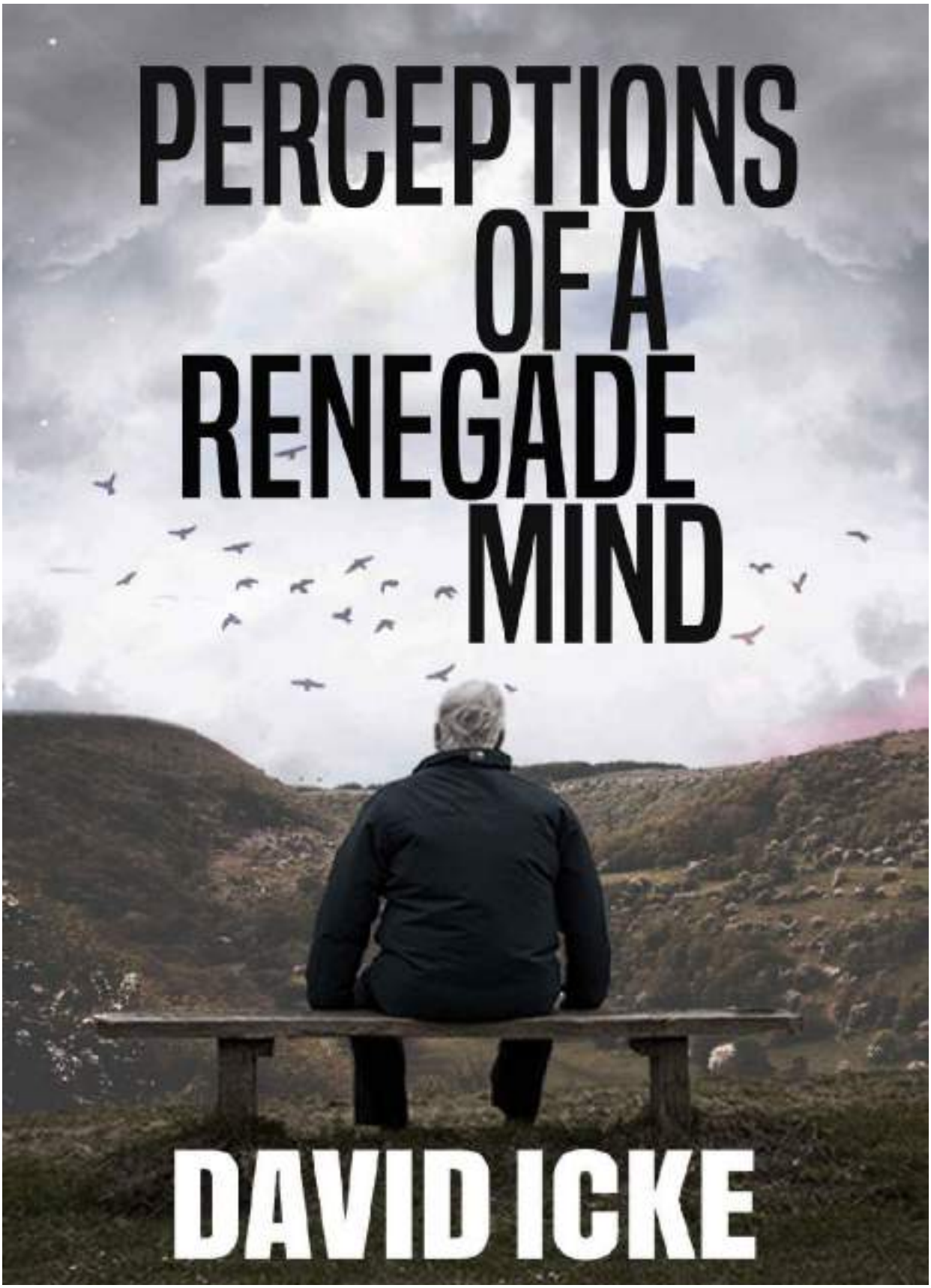
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PERCEPTIONS OF A RENEGADE MIND

DAVID ICKE

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Renegade:
Adjective
‘Having rejected tradition: Unconventional.’
Merriam-Webster Dictionary

Acquiescence to tyranny is the death of the spirit

You may be 38 years old, as I happen to be. And one day, some great opportunity stands before you and calls you to stand up for some great principle, some great issue, some great cause. And you refuse to do it because you are afraid … You refuse to do it because you want to live longer … You're afraid that you will lose your job, or you are afraid that you will be criticised or that you will lose your popularity, or you're afraid that somebody will stab you, or shoot at you or bomb your house; so you refuse to take the stand.

Well, you may go on and live until you are 90, but you're just as dead at 38 as you would be at 90. And the cessation of breathing in your life is but the belated announcement of an earlier death of the spirit.

Martin Luther King

How the few control the many and always have – the many do whatever they're told

'Forward, the Light Brigade!'
Was there a man dismayed?
Not though the soldier knew
Someone had blundered.
Theirs not to make reply,
Theirs not to reason why,
Theirs but to do and die.
Into the valley of Death
Rode the six hundred.

Cannon to right of them,
Cannon to left of them,
Cannon in front of them
Volleyed and thundered;
Stormed at with shot and shell,
Boldly they rode and well,
Into the jaws of Death,
Into the mouth of hell
Rode the six hundred

Alfred Lord Tennyson (1809-1892)

The mist is lifting slowly
I can see the way ahead
And I've left behind the empty streets
That once inspired my life
And the strength of the emotion
Is like thunder in the air
'Cos the promise that we made each other
Haunts me to the end

The secret of your beauty
And the mystery of your soul
I've been searching for in everyone I meet
And the times I've been mistaken
It's impossible to say
And the grass is growing
Underneath our feet

The words that I remember
From my childhood still are true
That there's none so blind
As those who will not see
And to those who lack the courage
And say it's dangerous to try
Well they just don't know
That love eternal will not be denied

I know you're out there somewhere
Somewhere, somewhere
I know you're out there somewhere

Somewhere you can hear my voice
I know I'll find you somehow
Somehow, somehow
I know I'll find you somehow
And somehow I'll return again to you

The Moody Blues

Are you a gutless wonder - or a Renegade Mind?

Monuments put from pen to paper,
Turns me into a gutless wonder,
And if you tolerate this,
Then your children will be next.
Gravity keeps my head down,
Or is it maybe shame ...

Manic Street Preachers

Rise like lions after slumber
In unvanquishable number.
Shake your chains to earth like dew
Which in sleep have fallen on you.
Ye are many – they are few.

Percy Shelley

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CHAPTER ONE

I'm thinking' – Oh, but *are* you?

Think for yourself and let others enjoy the privilege of doing so too
Voltaire

French-born philosopher, mathematician and scientist René Descartes became famous for his statement in Latin in the 17th century which translates into English as: 'I think, therefore I am.'

On the face of it that is true. Thought reflects perception and perception leads to both behaviour and self-identity. In that sense 'we' are what we think. But who or what is doing the thinking and is thinking the only route to perception? Clearly, as we shall see, 'we' are not always the source of 'our' perception, indeed with regard to humanity as a whole this is rarely the case; and thinking is far from the only means of perception. Thought is the village idiot compared with other expressions of consciousness that we all have the potential to access and tap into. This has to be true when we *are* those other expressions of consciousness which are infinite in nature. We have forgotten this, or, more to the point, been manipulated to forget.

These are not just the esoteric musings of the navel. The whole foundation of human control and oppression is control of perception. Once perception is hijacked then so is behaviour which is dictated by perception. Collective perception becomes collective behaviour and collective behaviour is what we call human society. Perception is all and those behind human control know that which is

why perception is the target 24/7 of the psychopathic manipulators that I call the Global Cult. They know that if they dictate perception they will dictate behaviour and collectively dictate the nature of human society. They are further aware that perception is formed from information received and if they control the circulation of information they will to a vast extent direct human behaviour. Censorship of information and opinion has become globally Nazi-like in recent years and never more blatantly than since the illusory 'virus pandemic' was triggered out of China in 2019 and across the world in 2020. Why have billions submitted to house arrest and accepted fascistic societies in a way they would have never believed possible? Those controlling the information spewing from government, mainstream media and Silicon Valley (all controlled by the same Global Cult networks) told them they were in danger from a 'deadly virus' and only by submitting to house arrest and conceding their most basic of freedoms could they and their families be protected. This monumental and provable lie became the *perception* of the billions and therefore the *behaviour* of the billions. In those few words you have the whole structure and modus operandi of human control. Fear is a perception – **F**alse **E**motion **A**ppearing **R**eal – and fear is the currency of control. In short … get them by the balls (or give them the impression that you have) and their hearts and minds will follow. Nothing grips the dangly bits and freezes the rear-end more comprehensively than fear.

World number 1

There are two 'worlds' in what appears to be one 'world' and the prime difference between them is knowledge. First we have the mass of human society in which the population is maintained in coldly-calculated ignorance through control of information and the 'education' (indoctrination) system. That's all you really need to control to enslave billions in a perceptual delusion in which what are perceived to be *their* thoughts and opinions are ever-repeated mantras that the system has been downloading all their lives through 'education', media, science, medicine, politics and academia

in which the personnel and advocates are themselves overwhelmingly the perceptual products of the same repetition. Teachers and academics in general are processed by the same programming machine as everyone else, but unlike the great majority they never leave the 'education' program. It gripped them as students and continues to grip them as programmers of subsequent generations of students. The programmed become the programmers – the programmed programmers. The same can largely be said for scientists, doctors and politicians and not least because as the American writer Upton Sinclair said: 'It is difficult to get a man to understand something when his salary depends upon his not understanding it.' If your career and income depend on thinking the way the system demands then you will – bar a few free-minded exceptions – concede your mind to the Perceptual Mainframe that I call the Postage Stamp Consensus. This is a tiny band of perceived knowledge and possibility 'taught' (downloaded) in the schools and universities, pounded out by the mainstream media and on which all government policy is founded. Try thinking, and especially speaking and acting, outside of the 'box' of consensus and see what that does for your career in the Mainstream Everything which bullies, harasses, intimidates and ridicules the population into compliance. Here we have the simple structure which enslaves most of humanity in a perceptual prison cell for an entire lifetime and I'll go deeper into this process shortly. Most of what humanity is taught as fact is nothing more than programmed belief. American science fiction author Frank Herbert was right when he said: 'Belief can be manipulated. Only knowledge is dangerous.' In the 'Covid' age belief is promoted and knowledge is censored. It was always so, but never to the extreme of today.

World number 2

A 'number 2' is slang for 'doing a poo' and how appropriate that is when this other 'world' is doing just that on humanity every minute of every day. World number 2 is a global network of secret societies and semi-secret groups dictating the direction of society via

governments, corporations and authorities of every kind. I have spent more than 30 years uncovering and exposing this network that I call the Global Cult and knowing its agenda is what has made my books so accurate in predicting current and past events. Secret societies are secret for a reason. They want to keep their hoarded knowledge to themselves and their chosen initiates and to hide it from the population which they seek through ignorance to control and subdue. The whole foundation of the division between World 1 and World 2 is *knowledge*. What number 1 knows number 2 must not. Knowledge they have worked so hard to keep secret includes (a) the agenda to enslave humanity in a centrally-controlled global dictatorship, and (b) the nature of reality and life itself. The latter (b) must be suppressed to allow the former (a) to prevail as I shall be explaining. The way the Cult manipulates and interacts with the population can be likened to a spider's web. The 'spider' sits at the centre in the shadows and imposes its will through the web with each strand represented in World number 2 by a secret society, satanic or semi-secret group, and in World number 1 – the world of the seen – by governments, agencies of government, law enforcement, corporations, the banking system, media conglomerates and Silicon Valley (Fig 1 overleaf). The spider and the web connect and coordinate all these organisations to pursue the same global outcome while the population sees them as individual entities working randomly and independently. At the level of the web governments *are* the banking system *are* the corporations *are* the media *are* Silicon Valley *are* the World Health Organization working from their inner cores as one unit. Apparently unconnected countries, corporations, institutions, organisations and people are on the *same team* pursuing the same global outcome. Strands in the web immediately around the spider are the most secretive and exclusive secret societies and their membership is emphatically restricted to the Cult inner-circle emerging through the generations from particular bloodlines for reasons I will come to. At the core of the core you would get them in a single room. That's how many people are dictating the direction of human society and its transformation

through the ‘Covid’ hoax and other means. As the web expands out from the spider we meet the secret societies that many people will be aware of – the Freemasons, Knights Templar, Knights of Malta, Opus Dei, the inner sanctum of the Jesuit Order, and such like. Note how many are connected to the Church of Rome and there is a reason for that. The Roman Church was established as a revamp, a rebranding, of the relocated ‘Church’ of Babylon and the Cult imposing global tyranny today can be tracked back to Babylon and Sumer in what is now Iraq.

Figure 1: The global web through which the few control the many. (Image Neil Hague.)

Inner levels of the web operate in the unseen away from the public eye and then we have what I call the cusp organisations located at the point where the hidden meets the seen. They include a series of satellite organisations answering to a secret society founded in London in the late 19th century called the Round Table and among them are the Royal Institute of International Affairs (UK, founded in 1920); Council on Foreign Relations (US, 1921); Bilderberg Group (worldwide, 1954); Trilateral Commission (US/worldwide, 1972); and the Club of Rome (worldwide, 1968) which was created to exploit environmental concerns to justify the centralisation of global power to ‘save the planet’. The Club of Rome instigated with others the human-caused climate change hoax which has led to all the ‘green

new deals' demanding that very centralisation of control. Cusp organisations, which include endless 'think tanks' all over the world, are designed to coordinate a single global policy between political and business leaders, intelligence personnel, media organisations and anyone who can influence the direction of policy in their own sphere of operation. Major players and regular attenders will know what is happening – or some of it – while others come and go and are kept overwhelmingly in the dark about the big picture. I refer to these cusp groupings as semi-secret in that they can be publicly identified, but what goes on at the inner-core is kept very much 'in house' even from most of their members and participants through a fiercely-imposed system of compartmentalisation. Only let them know what they need to know to serve your interests and no more. The structure of secret societies serves as a perfect example of this principle. Most Freemasons never get higher than the bottom three levels of 'degree' (degree of knowledge) when there are 33 official degrees of the Scottish Rite. Initiates only qualify for the next higher 'compartment' or degree if those at that level choose to allow them. Knowledge can be carefully assigned only to those considered 'safe'. I went to my local Freemason's lodge a few years ago when they were having an 'open day' to show how cuddly they were and when I chatted to some of them I was astonished at how little the rank and file knew even about the most ubiquitous symbols they use. The mushroom technique – keep them in the dark and feed them bullshit – applies to most people in the web as well as the population as a whole. Sub-divisions of the web mirror in theme and structure transnational corporations which have a headquarters somewhere in the world dictating to all their subsidiaries in different countries. Subsidiaries operate in their methodology and branding to the same centrally-dictated plan and policy in pursuit of particular ends. The Cult web functions in the same way. Each country has its own web as a subsidiary of the global one. They consist of networks of secret societies, semi-secret groups and bloodline families and their job is to impose the will of the spider and the global web in their particular country. Subsidiary networks control and manipulate the national political system, finance, corporations, media, medicine, etc. to

ensure that they follow the globally-dictated Cult agenda. These networks were the means through which the 'Covid' hoax could be played out with almost every country responding in the same way.

The 'Yessir' pyramid

Compartmentalisation is the key to understanding how a tiny few can dictate the lives of billions when combined with a top-down sequence of imposition and acquiescence. The inner core of the Cult sits at the peak of the pyramidal hierarchy of human society (Fig 2 overleaf). It imposes its will – its agenda for the world – on the level immediately below which acquiesces to that imposition. This level then imposes the Cult will on the level below them which acquiesces and imposes on the next level. Very quickly we meet levels in the hierarchy that have no idea there even is a Cult, but the sequence of imposition and acquiescence continues down the pyramid in just the same way. 'I don't know why we are doing this but the order came from "on-high" and so we better just do it.' Alfred Lord Tennyson said of the cannon fodder levels in his poem *The Charge of the Light Brigade*: 'Theirs not to reason why; theirs but to do and die.' The next line says that 'into the valley of death rode the six hundred' and they died because they obeyed without question what their perceived 'superiors' told them to do. In the same way the population capitulated to 'Covid'. The whole hierarchical pyramid functions like this to allow the very few to direct the enormous many. Eventually imposition-acquiescence-imposition-acquiescence comes down to the mass of the population at the foot of the pyramid. If they acquiesce to those levels of the hierarchy imposing on them (governments/law enforcement/doctors/media) a circuit is completed between the population and the handful of super-psychopaths in the Cult inner core at the top of the pyramid. Without a circuit-breaking refusal to obey, the sequence of imposition and acquiescence allows a staggeringly few people to impose their will upon the entirety of humankind. We are looking at the very sequence that has subjugated billions since the start of 2020. Our freedom has not been taken from us. Humanity has given it

away. Fascists do not impose fascism because there are not enough of them. Fascism is imposed by the population acquiescing to fascism. Put another way allowing their perceptions to be programmed to the extent that leads to the population giving their freedom away by giving their perceptions – their mind – away. If this circuit is not broken by humanity ceasing to cooperate with their own enslavement then nothing can change. For that to happen people have to critically think and see through the lies and window dressing and then summon the backbone to act upon what they see. The Cult spends its days working to stop either happening and its methodology is systematic and highly detailed, but it can be overcome and that is what this book is all about.

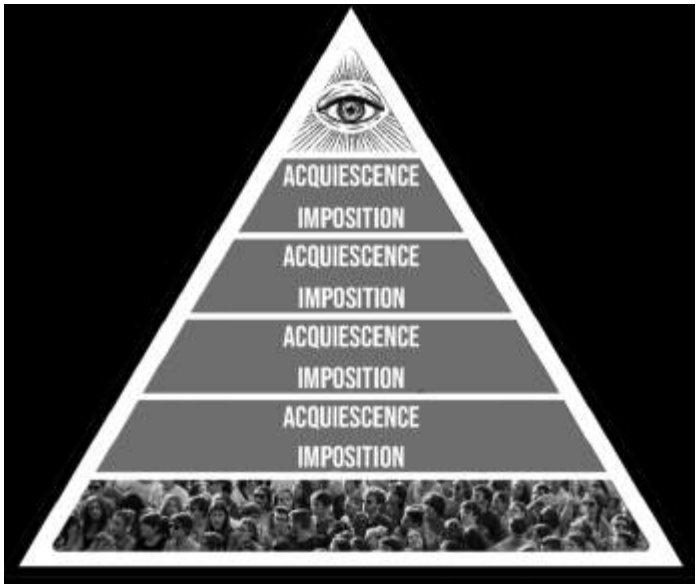

Figure 2: The simple sequence of imposition and compliance that allows a handful of people at the peak of the pyramid to dictate the lives of billions.

The Life Program

Okay, back to world number 1 or the world of the 'masses'. Observe the process of what we call 'life' and it is a perceptual download from cradle to grave. The Cult has created a global structure in which perception can be programmed and the program continually topped-up with what appears to be constant confirmation that the program is indeed true reality. The important word here is 'appears'.

This is the structure, the fly-trap, the Postage Stamp Consensus or Perceptual Mainframe, which represents that incredibly narrow band of perceived possibility delivered by the 'education' system, mainstream media, science and medicine. From the earliest age the download begins with parents who have themselves succumbed to the very programming their children are about to go through. Most parents don't do this out of malevolence and mostly it is quite the opposite. They do what they believe is best for their children and that is what the program has told them is best. Within three or four years comes the major transition from parental programming to full-blown state (Cult) programming in school, college and university where perceptually-programmed teachers and academics pass on their programming to the next generations. Teachers who resist are soon marginalised and their careers ended while children who resist are called a problem child for whom Ritalin may need to be prescribed. A few years after entering the 'world' children are under the control of authority figures representing the state telling them when they have to be there, when they can leave and when they can speak, eat, even go to the toilet. This is calculated preparation for a lifetime of obeying authority in all its forms. Reflex-action fear of authority is instilled by authority from the start. Children soon learn the carrot and stick consequences of obeying or defying authority which is underpinned daily for the rest of their life. Fortunately I daydreamed through this crap and never obeyed authority simply because it told me to. This approach to my alleged 'betters' continues to this day. There can be consequences of pursuing open-minded freedom in a world of closed-minded conformity. I spent a lot of time in school corridors after being ejected from the classroom for not taking some of it seriously and now I spend a lot of time being ejected from Facebook, YouTube and Twitter. But I can tell you that being true to yourself and not compromising your self-respect is far more exhilarating than bowing to authority for authority's sake. You don't have to be a sheep to the shepherd (authority) and the sheep dog (fear of not obeying authority).

The perceptual download continues throughout the formative years in school, college and university while script-reading 'teachers', 'academics' 'scientists', 'doctors' and 'journalists' insist that ongoing generations must be as programmed as they are. Accept the program or you will not pass your 'exams' which confirm your 'degree' of programming. It is tragic to think that many parents pressure their offspring to work hard at school to download the program and qualify for the next stage at college and university. The late, great, American comedian George Carlin said: 'Here's a bumper sticker I'd like to see: We are proud parents of a child who has resisted his teachers' attempts to break his spirit and bend him to the will of his corporate masters.' Well, the best of luck finding many of those, George. Then comes the moment to leave the formal programming years in academia and enter the 'adult' world of work. There you meet others in your chosen or prescribed arena who went through the same Postage Stamp Consensus program before you did. There is therefore overwhelming agreement between almost everyone on the basic foundations of Postage Stamp reality and the rejection, even contempt, of the few who have a mind of their own and are prepared to use it. This has two major effects. Firstly, the consensus confirms to the programmed that their download is really how things are. I mean, everyone knows that, right? Secondly, the arrogance and ignorance of Postage Stamp adherents ensure that anyone questioning the program will have unpleasant consequences for seeking their own truth and not picking their perceptions from the shelf marked: 'Things you must believe without question and if you don't you're a dangerous lunatic conspiracy theorist and a harebrained nutter'.

Every government, agency and corporation is founded on the same Postage Stamp prison cell and you can see why so many people believe the same thing while calling it their own 'opinion'. Fusion of governments and corporations in pursuit of the same agenda was the definition of fascism described by Italian dictator Benito Mussolini. The pressure to conform to perceptual norms downloaded for a lifetime is incessant and infiltrates society right

down to family groups that become censors and condemners of their own 'black sheep' for not, ironically, being sheep. We have seen an explosion of that in the 'Covid' era. Cult-owned global media unleashes its propaganda all day every day in support of the Postage Stamp and targets with abuse and ridicule anyone in the public eye who won't bend their mind to the will of the tyranny. Any response to this is denied (certainly in my case). They don't want to give a platform to expose official lies. Cult-owned-and-created Internet giants like Facebook, Google, YouTube and Twitter delete you for having an unapproved opinion. Facebook boasts that its AI censors delete 97-percent of 'hate speech' before anyone even reports it. Much of that 'hate speech' will simply be an opinion that Facebook and its masters don't want people to see. Such perceptual oppression is widely known as fascism. Even Facebook executive Benny Thomas, a 'CEO Global Planning Lead', said in comments secretly recorded by investigative journalism operation Project Veritas that Facebook is 'too powerful' and should be broken up:

I mean, no king in history has been the ruler of two billion people, but Mark Zuckerberg is … And he's 36. That's too much for a 36-year-old ... You should not have power over two billion people. I just think that's wrong.

Thomas said Facebook-owned platforms like Instagram, Oculus, and WhatsApp needed to be separate companies. 'It's too much power when they're all one together'. That's the way the Cult likes it, however. We have an executive of a Cult organisation in Benny Thomas that doesn't know there is a Cult such is the compartmentalisation. Thomas said that Facebook and Google 'are no longer companies, they're countries'. Actually they are more powerful than countries on the basis that if you control information you control perception and control human society.

I love my oppressor

Another expression of this psychological trickery is for those who realise they are being pressured into compliance to eventually

convince themselves to believe the official narratives to protect their self-respect from accepting the truth that they have succumbed to meek and subservient compliance. Such people become some of the most vehement defenders of the system. You can see them everywhere screaming abuse at those who prefer to think for themselves and by doing so reminding the compliers of their own capitulation to conformity. 'You are talking dangerous nonsense you Covidiot!!' Are you trying to convince me or yourself? It is a potent form of Stockholm syndrome which is defined as: 'A psychological condition that occurs when a victim of abuse identifies and attaches, or bonds, positively with their abuser.' An example is hostages bonding and even 'falling in love' with their kidnappers. The syndrome has been observed in domestic violence, abused children, concentration camp inmates, prisoners of war and many and various Satanic cults. These are some traits of Stockholm syndrome listed at goodtherapy.org:

- Positive regard towards perpetrators of abuse or captor [see 'Covid'].
- Failure to cooperate with police and other government authorities when it comes to holding perpetrators of abuse or kidnapping accountable [or in the case of 'Covid' cooperating with the police to enforce and defend their captors' demands].
- Little or no effort to escape [see 'Covid'].
- Belief in the goodness of the perpetrators or kidnappers [see 'Covid'].
- Appeasement of captors. This is a manipulative strategy for maintaining one's safety. As victims get rewarded – perhaps with less abuse or even with life itself – their appeasing behaviours are reinforced [see 'Covid'].
- Learned helplessness. This can be akin to 'if you can't beat 'em, join 'em'. As the victims fail to escape the abuse or captivity, they may start giving up and soon realize it's just easier for everyone if they acquiesce all their power to their captors [see 'Covid'].

- Feelings of pity toward the abusers, believing they are actually victims themselves. Because of this, victims may go on a crusade or mission to 'save' [protect] their abuser [see the venom unleashed on those challenging the official 'Covid' narrative].
- Unwillingness to learn to detach from their perpetrators and heal. In essence, victims may tend to be less loyal to themselves than to their abuser [*definitely* see 'Covid'].

Ponder on those traits and compare them with the behaviour of great swathes of the global population who have defended governments and authorities which have spent every minute destroying their lives and livelihoods and those of their children and grandchildren since early 2020 with fascistic lockdowns, house arrest and employment deletion to 'protect' them from a 'deadly virus' that their abusers' perceptually created to bring about this very outcome. We are looking at mass Stockholm syndrome. All those that agree to concede their freedom will believe those perceptions are originating in their own independent 'mind' when in fact by conceding their reality to Stockholm syndrome they have by definition conceded any independence of mind. Listen to the 'opinions' of the acquiescing masses in this 'Covid' era and what gushes forth is the repetition of the official version of everything delivered unprocessed, unfiltered and unquestioned. The whole programming dynamic works this way. I must be free because I'm told that I am and so I think that I am.

You can see what I mean with the chapter theme of 'I'm thinking – Oh, but *are* you?' The great majority are not thinking, let alone for themselves. They are repeating what authority has told them to believe which allows them to be controlled. Weaving through this mentality is the fear that the 'conspiracy theorists' are right and this again explains the often hysterical abuse that ensues when you dare to contest the official narrative of anything. Denial is the mechanism of hiding from yourself what you don't want to be true. Telling people what they want to hear is easy, but it's an infinitely greater challenge to tell them what they would rather not be happening.

One is akin to pushing against an open door while the other is met with vehement resistance no matter what the scale of evidence. I don't want it to be true so I'll convince myself that it's not. Examples are everywhere from the denial that a partner is cheating despite all the signs to the reflex-action rejection of any idea that world events in which country after country act in exactly the same way are centrally coordinated. To accept the latter is to accept that a force of unspeakable evil is working to destroy your life and the lives of your children with nothing too horrific to achieve that end. Who the heck wants that to be true? But if we don't face reality the end is duly achieved and the consequences are far worse and ongoing than breaking through the walls of denial today with the courage to make a stand against tyranny.

Connect the dots – but how?

A crucial aspect of perceptual programming is to portray a world in which everything is random and almost nothing is connected to anything else. Randomness cannot be coordinated by its very nature and once you perceive events as random the idea they could be connected is waved away as the rantings of the tinfoil-hat brigade. You can't plan and coordinate random you idiot! No, you can't, but you can hide the coldly-calculated and long-planned behind the *illusion* of randomness. A foundation manifestation of the Renegade Mind is to scan reality for patterns that connect the apparently random and turn pixels and dots into pictures. This is the way I work and have done so for more than 30 years. You look for similarities in people, modus operandi and desired outcomes and slowly, then ever quicker, the picture forms. For instance: There would seem to be no connection between the 'Covid pandemic' hoax and the human-caused global-warming hoax and yet they are masks (appropriately) on the same face seeking the same outcome. Those pushing the global warming myth through the Club of Rome and other Cult agencies are driving the lies about 'Covid' – Bill Gates is an obvious one, but they are endless. Why would the same people be involved in both when they are clearly not connected? Oh, but they

are. Common themes with personnel are matched by common goals. The 'solutions' to both 'problems' are centralisation of global power to impose the will of the few on the many to 'save' humanity from 'Covid' and save the planet from an 'existential threat' (we need 'zero Covid' and 'zero carbon emissions'). These, in turn, connect with the 'dot' of globalisation which was coined to describe the centralisation of global power in every area of life through incessant political and corporate expansion, trading blocks and superstates like the European Union. If you are the few and you want to control the many you have to centralise power and decision-making. The more you centralise power the more power the few at the centre will have over the many; and the more that power is centralised the more power those at the centre have to centralise even quicker. The momentum of centralisation gets faster and faster which is exactly the process we have witnessed. In this way the hoaxed 'pandemic' and the fakery of human-caused global warming serve the interests of globalisation and the seizure of global power in the hands of the Cult inner-circle which is behind 'Covid', 'climate change' *and* globalisation. At this point random 'dots' become a clear and obvious picture or pattern.

Klaus Schwab, the classic Bond villain who founded the Cult's Gates-funded World Economic Forum, published a book in 2020, *The Great Reset*, in which he used the 'problem' of 'Covid' to justify a total transformation of human society to 'save' humanity from 'climate change'. Schwab said: 'The pandemic represents a rare but narrow window of opportunity to reflect, reimagine, and reset our world.' What he didn't mention is that the Cult he serves is behind both hoaxes as I show in my book *The Answer*. He and the Cult don't have to reimagine the world. They know precisely what they want and that's why they destroyed human society with 'Covid' to 'build back better' in their grand design. Their job is not to imagine, but to get humanity to imagine and agree with their plans while believing it's all random. It must be pure coincidence that 'The Great Reset' has long been the Cult's code name for the global imposition of fascism and replaced previous code-names of the 'New World

Order' used by Cult frontmen like Father George Bush and the 'New Order of the Ages' which emerged from Freemasonry and much older secret societies. New Order of the Ages appears on the reverse of the Great Seal of the United States as 'Novus ordo seclorum' underneath the Cult symbol used since way back of the pyramid and all seeing-eye (Fig 3). The pyramid is the hierarchy of human control headed by the illuminated eye that symbolises the force behind the Cult which I will expose in later chapters. The term 'Annuit Coeptis' translates as 'He favours our undertaking'. We are told the 'He' is the Christian god, but 'He' is not as I will be explaining.

Figure 3: The all-seeing eye of the Cult 'god' on the Freemason-designed Great Seal of the United States and also on the dollar bill.

Having you on

Two major Cult techniques of perceptual manipulation that relate to all this are what I have called since the 1990s Problem-Reaction-Solution (PRS) and the Totalitarian Tiptoe (TT). They can be uncovered by the inquiring mind with a simple question: Who benefits? The answer usually identifies the perpetrators of a given action or happening through the concept of 'he who most benefits from a crime is the one most likely to have committed it'. The Latin 'Cue bono?' – Who benefits? – is widely attributed to the Roman orator and statesman Marcus Tullius Cicero. No wonder it goes back so far when the concept has been relevant to human behaviour since

history was recorded. Problem-Reaction-Solution is the technique used to manipulate us every day by covertly creating a problem (or the illusion of one) and offering the solution to the problem (or the illusion of one). In the first phase you create the problem and blame someone or something else for why it has happened. This may relate to a financial collapse, terrorist attack, war, global warming or pandemic, anything in fact that will allow you to impose the 'solution' to change society in the way you desire at that time. The 'problem' doesn't have to be real. PRS is manipulation of perception and all you need is the population to believe the problem is real. Human-caused global warming and the 'Covid pandemic' only have to be *perceived* to be real for the population to accept the 'solutions' of authority. I refer to this technique as NO-Problem-Reaction-Solution. Billions did not meekly accept house arrest from early 2020 because there was a real deadly 'Covid pandemic' but because they perceived – believed – that to be the case. The antidote to Problem-Reaction-Solution is to ask who benefits from the proposed solution. Invariably it will be anyone who wants to justify more control through deletion of freedom and centralisation of power and decision-making.

The two world wars were Problem-Reaction-Solutions that transformed and realigned global society. Both were manipulated into being by the Cult as I have detailed in books since the mid-1990s. They dramatically centralised global power, especially World War Two, which led to the United Nations and other global bodies thanks to the overt and covert manipulations of the Rockefeller family and other Cult bloodlines like the Rothschilds. The UN is a stalking horse for full-blown world government that I will come to shortly. The land on which the UN building stands in New York was donated by the Rockefellers and the same Cult family was behind Big Pharma scalpel and drug 'medicine' and the creation of the World Health Organization as part of the UN. They have been stalwarts of the eugenics movement and funded Hitler's race-purity expert' Ernst Rudin. The human-caused global warming hoax has been orchestrated by the Club of Rome through the UN which is

manufacturing both the 'problem' through its Intergovernmental Panel on Climate Change and imposing the 'solution' through its Agenda 21 and Agenda 2030 which demand the total centralisation of global power to 'save the world' from a climate hoax the United Nations is itself perpetrating. What a small world the Cult can be seen to be particularly among the inner circles. The bedfellow of Problem-Reaction-Solution is the Totalitarian Tiptoe which became the Totalitarian Sprint in 2020. The technique is fashioned to hide the carefully-coordinated behind the cover of apparently random events. You start the sequence at 'A' and you know you are heading for 'Z'. You don't want people to know that and each step on the journey is presented as a random happening while all the steps strung together lead in the same direction. The speed may have quickened dramatically in recent times, but you can still see the incremental approach of the Tiptoe in the case of 'Covid' as each new imposition takes us deeper into fascism. Tell people they have to do this or that to get back to 'normal', then this and this and this. With each new demand adding to the ones that went before the population's freedom is deleted until it disappears. The spider wraps its web around the flies more comprehensively with each new diktat. I'll highlight this in more detail when I get to the 'Covid' hoax and how it has been pulled off. Another prime example of the Totalitarian Tiptoe is how the Cult-created European Union went from a 'free-trade zone' to a centralised bureaucratic dictatorship through the Tiptoe of incremental centralisation of power until nations became mere administrative units for Cult-owned dark suits in Brussels.

The antidote to ignorance is knowledge which the Cult seeks vehemently to deny us, but despite the systematic censorship to that end the Renegade Mind can overcome this by vociferously seeking out the facts no matter the impediments put in the way. There is also a method of thinking and perceiving – *knowing* – that doesn't even need names, dates, place-type facts to identify the patterns that reveal the story. I'll get to that in the final chapter. All you need to know about the manipulation of human society and to what end is still out there – *at the time of writing* – in the form of books, videos

and websites for those that really want to breach the walls of programmed perception. To access this knowledge requires the abandonment of the mainstream media as a source of information in the awareness that this is owned and controlled by the Cult and therefore promotes mass perceptions that suit the Cult. Mainstream media lies all day, every day. That is its function and very reason for being. Where it does tell the truth, here and there, is only because the truth and the Cult agenda very occasionally coincide. If you look for fact and insight to the BBC, CNN and virtually all the rest of them you are asking to be conned and perceptually programmed.

Know the outcome and you'll see the journey

Events seem random when you have no idea where the world is being taken. Once you do the random becomes the carefully planned. Know the outcome and you'll see the journey is a phrase I have been using for a long time to give context to daily happenings that appear unconnected. Does a problem, or illusion of a problem, trigger a proposed 'solution' that further drives society in the direction of the outcome? Invariably the answer will be yes and the random – *abracadabra* – becomes the clearly coordinated. So what is this outcome that unlocks the door to a massively expanded understanding of daily events? I will summarise its major aspects – the fine detail is in my other books – and those new to this information will see that the world they thought they were living in is a very different place. The foundation of the Cult agenda is the incessant centralisation of power and all such centralisation is ultimately in pursuit of Cult control on a global level. I have described for a long time the planned world structure of top-down dictatorship as the Hunger Games Society. The term obviously comes from the movie series which portrayed a world in which a few living in military-protected hi-tech luxury were the overlords of a population condemned to abject poverty in isolated 'sectors' that were not allowed to interact. 'Covid' lockdowns and travel bans anyone? The 'Hunger Games' pyramid of structural control has the inner circle of the Cult at the top with pretty much the entire

population at the bottom under their control through dependency for survival on the Cult. The whole structure is planned to be protected and enforced by a military-police state (Fig 4).

Here you have the reason for the global lockdowns of the fake pandemic to coldly destroy independent incomes and livelihoods and make everyone dependent on the 'state' (the Cult that controls the 'states'). I have warned in my books for many years about the plan to introduce a 'guaranteed income' – a barely survivable pittance – designed to impose dependency when employment was destroyed by AI technology and now even more comprehensively at great speed by the 'Covid' scam. Once the pandemic was played and lockdown consequences began to delete independent income the authorities began to talk right on cue about the need for a guaranteed income and a 'Great Reset'. Guaranteed income will be presented as benevolent governments seeking to help a desperate people – desperate as a direct result of actions of the same governments. The truth is that such payments are a trap. You will only get them if you do exactly what the authorities demand including mass vaccination (genetic manipulation). We have seen this theme already in Australia where those dependent on government benefits have them reduced if parents don't agree to have their children vaccinated according to an insane health-destroying government-dictated schedule. Calculated economic collapse applies to governments as well as people. The Cult wants rid of countries through the creation of a world state with countries broken up into regions ruled by a world government and super states like the European Union. Countries must be bankrupted, too, to this end and it's being achieved by the trillions in 'rescue packages' and furlough payments, trillions in lost taxation, and money-no-object spending on 'Covid' including constant all-medium advertising (programming) which has made the media dependent on government for much of its income. The day of reckoning is coming – as planned – for government spending and given that it has been made possible by printing money and not by production/taxation there is inflation on the way that has the

potential to wipe out monetary value. In that case there will be no need for the Cult to steal your money. It just won't be worth anything (see the German Weimar Republic before the Nazis took over). Many have been okay with lockdowns while getting a percentage of their income from so-called furlough payments without having to work. Those payments are dependent, however, on people having at least a theoretical job with a business considered non-essential and ordered to close. As these business go under because they are closed by lockdown after lockdown the furlough stops and it will for everyone eventually. Then what? The 'then what?' is precisely the idea.

THE COVID-19 CREATED HUNGER GAMES SOCIETY
THE ELITE - 1%
THE GLOBAL POLICE STATE
MANDATORY VACCINATION - ID - SOCIAL CREDIT - 666
CLOSED
FOOD BANK
THE MASSES LIVING IN POVERTY

Figure 4: The Hunger Games Society structure I have long warned was planned and now the 'Covid' hoax has made it possible. This is the real reason for lockdowns.

Hired hands

Between the Hunger Games Cult elite and the dependent population is planned to be a vicious military-police state (a fusion of the two into one force). This has been in the making for a long time with police looking ever more like the military and carrying weapons to match. The pandemic scam has seen this process accelerate so fast as

lockdown house arrest is brutally enforced by carefully recruited fascist minds and gormless system-servers. The police and military are planned to merge into a centrally-directed world army in a global structure headed by a world government which wouldn't be elected even by the election fixes now in place. The world army is not planned even to be human and instead wars would be fought, primarily against the population, using robot technology controlled by artificial intelligence. I have been warning about this for decades and now militaries around the world are being transformed by this very AI technology. The global regime that I describe is a particular form of fascism known as a technocracy in which decisions are not made by clueless and co-opted politicians but by unelected technocrats – scientists, engineers, technologists and bureaucrats. Cult-owned-and-controlled Silicon Valley giants are examples of technocracy and they already have far more power to direct world events than governments. They are with their censorship *selecting* governments. I know that some are calling the 'Great Reset' a Marxist communist takeover, but fascism and Marxism are different labels for the same tyranny. Tell those who lived in fascist Germany and Stalinist Russia that there was a difference in the way their freedom was deleted and their lives controlled. I could call it a fascist technocracy or a Marxist technocracy and they would be equally accurate. The Hunger Games society with its world government structure would oversee a world army, world central bank and single world cashless currency imposing its will on a microchipped population (Fig 5). Scan its different elements and see how the illusory pandemic is forcing society in this very direction at great speed. Leaders of 23 countries and the World Health Organization (WHO) backed the idea in March, 2021, of a global treaty for 'international cooperation' in 'health emergencies' and nations should 'come together as a global community for peaceful cooperation that extends beyond this crisis'. Cut the Orwellian bullshit and this means another step towards global government. The plan includes a cashless digital money system that I first warned about in 1993. Right at the start of 'Covid' the deeply corrupt Tedros

Adhanom Ghebreyesus, the crooked and merely gofer 'head' of the World Health Organization, said it was possible to catch the 'virus' by touching cash and it was better to use cashless means. The claim was ridiculous nonsense and like the whole 'Covid' mind-trick it was nothing to do with 'health' and everything to do with pushing every aspect of the Cult agenda. As a result of the Tedros lie the use of cash has plummeted. The Cult script involves a single world digital currency that would eventually be technologically embedded in the body. China is a massive global centre for the Cult and if you watch what is happening there you will know what is planned for everywhere. The Chinese government is developing a digital currency which would allow fines to be deducted immediately via AI for anyone caught on camera breaking its fantastic list of laws and the money is going to be programmable with an expiry date to ensure that no one can accrue wealth except the Cult and its operatives.

WORLD GOVERNMENT
UNELECTED - RUN BY TECHNOCRATS
WORLD ARMY • CENTRAL BANK • CURRENCY •
HUMANS CONNECTED TO A.I.
SUPERSTATES LIKE THE EU AND CENTRALLY
CONTROLLED 'TRADING BLOCS'
COUNTRIES REPLACED BY POWERLESS REGIONS
GLOBAL MONOCULTURE
THE PEOPLE

Figure 5: The structure of global control the Cult has been working towards for so long and this has been enormously advanced by the 'Covid' illusion.

Serfdom is so smart

The Cult plan is far wider, extreme, and more comprehensive than even most conspiracy researchers appreciate and I will come to the true depths of deceit and control in the chapters 'Who controls the

Cult?' and 'Escaping Wetiko'. Even the world that we know is crazy enough. We are being deluged with ever more sophisticated and controlling technology under the heading of 'smart'. We have smart televisions, smart meters, smart cards, smart cars, smart driving, smart roads, smart pills, smart patches, smart watches, smart skin, smart borders, smart pavements, smart streets, smart cities, smart communities, smart environments, smart growth, smart planet ... smart *everything* around us. Smart technologies and methods of operation are designed to interlock to create a global Smart Grid connecting the entirety of human society including human minds to create a centrally-dictated 'hive' mind. 'Smart cities' is code for densely-occupied megacities of total surveillance and control through AI. Ever more destructive frequency communication systems like 5G have been rolled out without any official testing for health and psychological effects (colossal). 5G/6G/7G systems are needed to run the Smart Grid and each one becomes more destructive of body and mind. Deleting independent income is crucial to forcing people into these AI-policed prisons by ending private property ownership (except for the Cult elite). The Cult's Great Reset now openly foresees a global society in which no one will own any possessions and everything will be rented while the Cult would own literally everything under the guise of government and corporations. The aim has been to use the lockdowns to destroy sources of income on a mass scale and when the people are destitute and in unrepayable amounts of debt (problem) Cult assets come forward with the pledge to write-off debt in return for handing over all property and possessions (solution). Everything – literally everything including people – would be connected to the Internet via AI. I was warning years ago about the coming Internet of Things (IoT) in which all devices and technology from your car to your fridge would be plugged into the Internet and controlled by AI. Now we are already there with much more to come. The next stage is the Internet of Everything (IoE) which is planned to include the connection of AI to the human brain and body to replace the human mind with a centrally-controlled AI mind. Instead of perceptions

being manipulated through control of information and censorship those perceptions would come direct from the Cult through AI. What do you think? You think whatever AI decides that you think. In human terms there would be no individual 'think' any longer. Too incredible? The ravings of a lunatic? Not at all. Cult-owned crazies in Silicon Valley have been telling us the plan for years without explaining the real motivation and calculated implications. These include Google executive and 'futurist' Ray Kurzweil who highlights the year 2030 for when this would be underway. He said:

Our thinking ... will be a hybrid of biological and non-biological thinking ... humans will be able to extend their limitations and 'think in the cloud' ... We're going to put gateways to the cloud in our brains ... We're going to gradually merge and enhance ourselves ... In my view, that's the nature of being human – we transcend our limitations.

As the technology becomes vastly superior to what we are then the small proportion that is still human gets smaller and smaller and smaller until it's just utterly negligible.

The sales-pitch of Kurzweil and Cult-owned Silicon Valley is that this would make us 'super-human' when the real aim is to make us post-human and no longer 'human' in the sense that we have come to know. The entire global population would be connected to AI and become the centrally-controlled 'hive-mind' of externally-delivered perceptions. The Smart Grid being installed to impose the Cult's will on the world is being constructed to allow particular locations – even one location – to control the whole global system. From these prime control centres, which absolutely include China and Israel, anything connected to the Internet would be switched on or off and manipulated at will. Energy systems could be cut, communication via the Internet taken down, computer-controlled driverless autonomous vehicles driven off the road, medical devices switched off, the potential is limitless given how much AI and Internet connections now run human society. We have seen nothing yet if we allow this to continue. Autonomous vehicle makers are working with law enforcement to produce cars designed to automatically pull over if they detect a police or emergency vehicle flashing from up to 100 feet away. At a police stop the car would be unlocked and the

window rolled down automatically. Vehicles would only take you where the computer (the state) allowed. The end of petrol vehicles and speed limiters on all new cars in the UK and EU from 2022 are steps leading to electric computerised transport over which ultimately you have no control. The picture is far bigger even than the Cult global network or web and that will become clear when I get to the nature of the 'spider'. There is a connection between all these happenings and the instigation of DNA-manipulating 'vaccines' (which aren't 'vaccines') justified by the 'Covid' hoax. That connection is the unfolding plan to transform the human body from a biological to a synthetic biological state and this is why synthetic biology is such a fast-emerging discipline of mainstream science. 'Covid vaccines' are infusing self-replicating synthetic genetic material into the cells to cumulatively take us on the Totalitarian Tiptoe from Human 1.0 to the synthetic biological Human 2.0 which will be physically and perceptually attached to the Smart Grid to one hundred percent control every thought, perception and deed. Humanity needs to wake up and *fast*.

This is the barest explanation of where the 'outcome' is planned to go but it's enough to see the journey happening all around us. Those new to this information will already see 'Covid' in a whole new context. I will add much more detail as we go along, but for the minutiae evidence see my mega-works, *The Answer, The Trigger* and *Everything You Need to Know But Have Never Been Told*.

Now – how does a Renegade Mind see the 'world'?

CHAPTER TWO

Renegade Perception

It is one thing to be clever and another to be wise
George R.R. Martin

A simple definition of the difference between a programmed mind and a Renegade Mind would be that one sees only dots while the other connects them to see the picture. Reading reality with accuracy requires the observer to (a) know the planned outcome and (b) realise that everything, but *everything*, is connected.

The entirety of infinite reality is connected – that's its very nature – and with human society an expression of infinite reality the same must apply. Simple cause and effect is a connection. The effect is triggered by the cause and the effect then becomes the cause of another effect. Nothing happens in isolation because it *can't*. Life in whatever reality is simple choice and consequence. We make choices and these lead to consequences. If we don't like the consequences we can make different choices and get different consequences which lead to other choices and consequences. The choice and the consequence are not only connected they are indivisible. You can't have one without the other as an old song goes. A few cannot control the world unless those being controlled allow that to happen – cause and effect, choice and consequence. Control – who has it and who doesn't – is a two-way process, a symbiotic relationship, involving the controller and controlled. 'They took my freedom away!!' Well, yes, but you also gave it to them. Humanity is

subjected to mass control because humanity has acquiesced to that control. This is all cause and effect and literally a case of give and take. In the same way world events of every kind are connected and the Cult works incessantly to sell the illusion of the random and coincidental to maintain the essential (to them) perception of dots that hide the picture. Renegade Minds know this and constantly scan the world for patterns of connection. This is absolutely pivotal in understanding the happenings in the world and without that perspective clarity is impossible. First you know the planned outcome and then you identify the steps on the journey – the day-by-day apparently random which, when connected in relation to the outcome, no longer appear as individual events, but as the proverbial *chain* of events leading in the same direction. I'll give you some examples:

Political puppet show

We are told to believe that politics is 'adversarial' in that different parties with different beliefs engage in an endless tussle for power. There may have been some truth in that up to a point – and only a point – but today divisions between 'different' parties are rhetorical not ideological. Even the rhetorical is fusing into one-speak as the parties eject any remaining free thinkers while others succumb to the ever-gathering intimidation of anyone with the 'wrong' opinion. The Cult is not a new phenomenon and can be traced back thousands of years as my books have documented. Its intergenerational initiates have been manipulating events with increasing effect the more that global power has been centralised. In ancient times the Cult secured control through the system of monarchy in which 'special' bloodlines (of which more later) demanded the right to rule as kings and queens simply by birthright and by vanquishing others who claimed the same birthright. There came a time, however, when people had matured enough to see the unfairness of such tyranny and demanded a say in who governed them. Note the word – *governed* them. Not served them – *governed* them, hence government defined as 'the political direction and control exercised over the

actions of the members, citizens, or inhabitants of communities, societies, and states; direction of the affairs of a state, community, etc.' Governments exercise control over rather than serve just like the monarchies before them. Bizarrely there are still countries like the United Kingdom which are ruled by a monarch *and* a government that officially answers to the monarch. The UK head of state and that of Commonwealth countries such as Canada, Australia and New Zealand is 'selected' by who in a *single family* had unprotected sex with whom and in what order. Pinch me it can't be true. Ouch! Shit, it is. The demise of monarchies in most countries offered a potential vacuum in which some form of free and fair society could arise and the Cult had that base covered. Monarchies had served its interests but they couldn't continue in the face of such widespread opposition and, anyway, replacing a 'royal' dictatorship that people could see with a dictatorship 'of the people' hiding behind the concept of 'democracy' presented far greater manipulative possibilities and ways of hiding coordinated tyranny behind the illusion of 'freedom'.

Democracy is quite wrongly defined as government selected by the population. This is not the case at all. It is government selected by *some* of the population (and then only in theory). This 'some' doesn't even have to be the majority as we have seen so often in first-past-the-post elections in which the so-called majority party wins fewer votes than the 'losing' parties combined. Democracy can give total power to a party in government from a minority of the votes cast. It's a sleight of hand to sell tyranny as freedom. Seventy-four million Trump-supporting Americans didn't vote for the 'Democratic' Party of Joe Biden in the distinctly dodgy election in 2020 and yet far from acknowledging the wishes and feelings of that great percentage of American society the Cult-owned Biden government set out from day one to destroy them and their right to a voice and opinion. Empty shell Biden and his Cult handlers said they were doing this to 'protect democracy'. Such is the level of lunacy and sickness to which politics has descended. Connect the dots and relate them to the desired outcome – a world government run by self-appointed technocrats and no longer even elected

politicians. While operating through its political agents in government the Cult is at the same time encouraging public distain for politicians by putting idiots and incompetents in theoretical power on the road to deleting them. The idea is to instil a public reaction that says of the technocrats: 'Well, they couldn't do any worse than the pathetic politicians.' It's all about controlling perception and Renegade Minds can see through that while programmed minds cannot when they are ignorant of both the planned outcome and the manipulation techniques employed to secure that end. This knowledge can be learned, however, and fast if people choose to get informed.

Politics may at first sight appear very difficult to control from a central point. I mean look at the 'different' parties and how would you be able to oversee them all and their constituent parts? In truth, it's very straightforward because of their structure. We are back to the pyramid of imposition and acquiescence. Organisations are structured in the same way as the system as a whole. Political parties are not open forums of free expression. They are hierarchies. I was a national spokesman for the British Green Party which claimed to be a different kind of politics in which influence and power was devolved; but I can tell you from direct experience – and it's far worse now – that Green parties are run as hierarchies like all the others however much they may try to hide that fact or kid themselves that it's not true. A very few at the top of all political parties are directing policy and personnel. They decide if you are elevated in the party or serve as a government minister and to do that you have to be a yes man or woman. Look at all the maverick political thinkers who never ascended the greasy pole. If you want to progress within the party or reach 'high-office' you need to fall into line and conform. Exceptions to this are rare indeed. Should you want to run for parliament or Congress you have to persuade the local or state level of the party to select you and for that you need to play the game as dictated by the hierarchy. If you secure election and wish to progress within the greater structure you need to go on conforming to what is acceptable to those running the hierarchy

from the peak of the pyramid. Political parties are perceptual gulags and the very fact that there are party 'Whips' appointed to 'whip' politicians into voting the way the hierarchy demands exposes the ridiculous idea that politicians are elected to serve the people they are supposed to represent. Cult operatives and manipulation has long seized control of major parties that have any chance of forming a government and at least most of those that haven't. A new party forms and the Cult goes to work to infiltrate and direct. This has reached such a level today that you see video compilations of 'leaders' of all parties whether Democrats, Republicans, Conservative, Labour and Green parroting the same Cult mantra of 'Build Back Better' and the 'Great Reset' which are straight off the Cult song-sheet to describe the transformation of global society in response to the Cult-instigated hoaxes of the 'Covid pandemic' and human-caused 'climate change'. To see Caroline Lucas, the Green Party MP that I knew when I was in the party in the 1980s, speaking in support of plans proposed by Cult operative Klaus Schwab representing the billionaire global elite is a real head-shaker.

Many parties – one master

The party system is another mind-trick and was instigated to change the nature of the dictatorship by swapping 'royalty' for dark suits that people believed – though now ever less so – represented their interests. Understanding this trick is to realise that a single force (the Cult) controls all parties either directly in terms of the major ones or through manipulation of perception and ideology with others. You don't need to manipulate Green parties to demand your transformation of society in the name of 'climate change' when they are obsessed with the lie that this is essential to 'save the planet'. You just give them a platform and away they go serving your interests while believing they are being environmentally virtuous. America's political structure is a perfect blueprint for how the two or multi-party system is really a one-party state. The Republican Party is controlled from one step back in the shadows by a group made up of billionaires and their gofers known as neoconservatives or Neocons.

I have exposed them in fine detail in my books and they were the driving force behind the policies of the imbecilic presidency of Boy George Bush which included 9/11 (see *The Trigger* for a comprehensive demolition of the official story), the subsequent 'war on terror' (war *of* terror) and the invasions of Afghanistan and Iraq. The latter was a No-Problem-Reaction-Solution based on claims by Cult operatives, including Bush and British Prime Minister Tony Blair, about Saddam Hussein's 'weapons of mass destruction' which did not exist as war criminals Bush and Blair well knew.

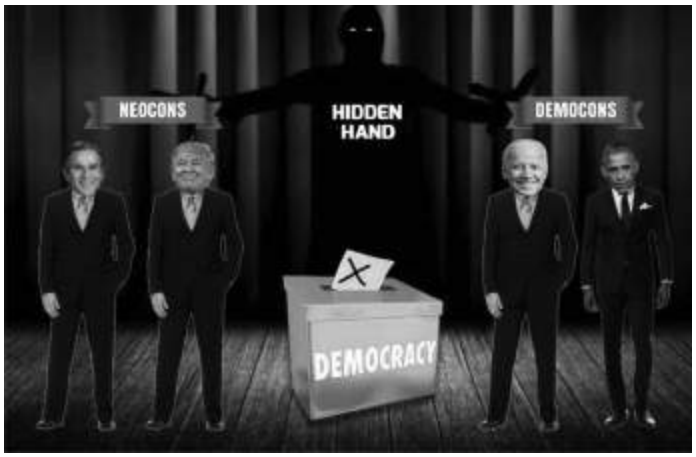

Figure 6: Different front people, different parties – same control system.

The Democratic Party has its own 'Neocon' group controlling from the background which I call the 'Democons' and here's the penny-drop – the Neocons and Democons answer to the same masters one step further back into the shadows (Fig 6). At that level of the Cult the Republican and Democrat parties are controlled by the same people and no matter which is in power the Cult is in power. This is how it works in almost every country and certainly in Britain with Conservative, Labour, Liberal Democrat and Green parties now all on the same page whatever the rhetoric may be in their feeble attempts to appear different. Neocons operated at the time of Bush through a think tank called The Project for the New American Century which in September, 2000, published a document entitled *Rebuilding America's Defenses: Strategies, Forces, and Resources*

For a New Century demanding that America fight 'multiple, simultaneous major theatre wars' as a 'core mission' to force regime-change in countries including Iraq, Libya and Syria. Neocons arranged for Bush ('Republican') and Blair ('Labour Party') to front-up the invasion of Iraq and when they departed the Democons orchestrated the targeting of Libya and Syria through Barack Obama ('Democrat') and British Prime Minister David Cameron ('Conservative Party'). We have 'different' parties and 'different' people, but the same unfolding script. The more the Cult has seized the reigns of parties and personnel the more their policies have transparently pursued the same agenda to the point where the fascist 'Covid' impositions of the Conservative junta of Jackboot Johnson in Britain were opposed by the Labour Party because they were not fascist enough. The Labour Party is likened to the US Democrats while the Conservative Party is akin to a British version of the Republicans and on both sides of the Atlantic they all speak the same language and support the direction demanded by the Cult although some more enthusiastically than others. It's a similar story in country after country because it's all centrally controlled. Oh, but what about Trump? I'll come to him shortly. Political 'choice' in the 'party' system goes like this: You vote for Party A and they get into government. You don't like what they do so next time you vote for Party B and they get into government. You don't like what they do when it's pretty much the same as Party A and why wouldn't that be with both controlled by the same force? Given that only two, sometimes three, parties have any chance of forming a government to get rid of Party B that you don't like you have to vote again for Party A which … you don't like. This, ladies and gentlemen, is what they call 'democracy' which we are told – wrongly – is a term interchangeable with 'freedom'.

The cult of cults

At this point I need to introduce a major expression of the Global Cult known as Sabbatian-Frankism. Sabbatian is also spelt as Sabbatean. I will summarise here. I have published major exposés

and detailed background in other works. Sabbatian-Frankism combines the names of two frauds posing as 'Jewish' men, Sabbatai Zevi (1626-1676), a rabbi, black magician and occultist who proclaimed he was the Jewish messiah; and Jacob Frank (1726-1791), the Polish 'Jew', black magician and occultist who said he was the reincarnation of 'messiah' Zevi and biblical patriarch Jacob. They worked across two centuries to establish the Sabbatian-Frankist cult that plays a major, indeed central, role in the manipulation of human society by the Global Cult which has its origins much further back in history than Sabbatai Zevi. I should emphasise two points here in response to the shrill voices that will scream 'anti-Semitism': (1) Sabbatian-Frankists are NOT Jewish and only pose as such to hide their cult behind a Jewish façade; and (2) my information about this cult has come from Jewish sources who have long realised that their society and community has been infiltrated and taken over by interloper Sabbatian-Frankists. Infiltration has been the foundation technique of Sabbatian-Frankism from its official origin in the 17th century. Zevi's Sabbatian sect attracted a massive following described as the biggest messianic movement in Jewish history, spreading as far as Africa and Asia, and he promised a return for the Jews to the 'Promised Land' of Israel. Sabbatianism was not Judaism but an inversion of everything that mainstream Judaism stood for. So much so that this sinister cult would have a feast day when Judaism had a fast day and whatever was forbidden in Judaism the Sabbatians were encouraged and even commanded to do. This included incest and what would be today called Satanism. Members were forbidden to marry outside the sect and there was a system of keeping their children ignorant of what they were part of until they were old enough to be trusted not to unknowingly reveal anything to outsiders. The same system is employed to this day by the Global Cult in general which Sabbatian-Frankism has enormously influenced and now largely controls.

Zevi and his Sabbatians suffered a setback with the intervention by the Sultan of the Islamic Ottoman Empire in the Middle East and what is now the Republic of Turkey where Zevi was located. The

Sultan gave him the choice of proving his 'divinity', converting to Islam or facing torture and death. Funnily enough Zevi chose to convert or at least appear to. Some of his supporters were disillusioned and drifted away, but many did not with 300 families also converting – only in theory – to Islam. They continued behind this Islamic smokescreen to follow the goals, rules and rituals of Sabbatianism and became known as 'crypto-Jews' or the 'Dönmeh' which means 'to turn'. This is rather ironic because they didn't 'turn' and instead hid behind a fake Islamic persona. The process of appearing to be one thing while being very much another would become the calling card of Sabbatianism especially after Zevi's death and the arrival of the Satanist Jacob Frank in the 18th century when the cult became Sabbatian-Frankism and plumbed still new depths of depravity and infiltration which included – still includes – human sacrifice and sex with children. Wherever Sabbatians go paedophilia and Satanism follow and is it really a surprise that Hollywood is so infested with child abuse and Satanism when it was established by Sabbatian-Frankists and is still controlled by them? Hollywood has been one of the prime vehicles for global perceptual programming and manipulation. How many believe the version of 'history' portrayed in movies when it is a travesty and inversion (again) of the truth? Rabbi Marvin Antelman describes Frankism in his book, *To Eliminate the Opiate*, as 'a movement of complete evil' while Jewish professor Gershom Scholem said of Frank in *The Messianic Idea in Judaism*: 'In all his actions [he was] a truly corrupt and degenerate individual ... one of the most frightening phenomena in the whole of Jewish history.' Frank was excommunicated by traditional rabbis, as was Zevi, but Frank was undeterred and enjoyed vital support from the House of Rothschild, the infamous banking dynasty whose inner-core are Sabbatian-Frankists and not Jews. Infiltration of the Roman Church and Vatican was instigated by Frank with many Dönmeh 'turning' again to convert to Roman Catholicism with a view to hijacking the reins of power. This was the ever-repeating modus operandi and continues to be so. Pose as an advocate of the religion, culture or country that you want to control and then

manipulate your people into the positions of authority and influence largely as advisers, administrators and Svengalis for those that appear to be in power. They did this with Judaism, Christianity (Christian Zionism is part of this), Islam and other religions and nations until Sabbatian-Frankism spanned the world as it does today.

Sabbatian Saudis and the terror network

One expression of the Sabbatian-Frankist Dönmeh within Islam is the ruling family of Saudi Arabia, the House of Saud, through which came the vile distortion of Islam known as Wahhabism. This is the violent creed followed by terrorist groups like Al-Qaeda and ISIS or Islamic State. Wahhabism is the hand-chopping, head-chopping 'religion' of Saudi Arabia which is used to keep the people in a constant state of fear so the interloper House of Saud can continue to rule. Al-Qaeda and Islamic State were lavishly funded by the House of Saud while being created and directed by the Sabbatian-Frankist network in the United States that operates through the Pentagon, CIA and the government in general of whichever 'party'. The front man for the establishment of Wahhabism in the middle of the 18th century was a Sabbatian-Frankist 'crypto-Jew' posing as Islamic called Muhammad ibn Abd al-Wahhab. His daughter would marry the son of Muhammad bin Saud who established the first Saudi state before his death in 1765 with support from the British Empire. Bin Saud's successors would establish modern Saudi Arabia in league with the British and Americans in 1932 which allowed them to seize control of Islam's major shrines in Mecca and Medina. They have dictated the direction of Sunni Islam ever since while Iran is the major centre of the Shiite version and here we have the source of at least the public conflict between them. The Sabbatian network has used its Wahhabi extremists to carry out Problem-Reaction-Solution terrorist attacks in the name of 'Al-Qaeda' and 'Islamic State' to justify a devastating 'war on terror', ever-increasing surveillance of the population and to terrify people into compliance. Another insight of the Renegade Mind is the streetwise understanding that

just because a country, location or people are attacked doesn't mean that those apparently representing that country, location or people are not behind the attackers. Often they are *orchestrating* the attacks because of the societal changes that can be then justified in the name of 'saving the population from terrorists'.

I show in great detail in *The Trigger* how Sabbatian-Frankists were the real perpetrators of 9/11 and not '19 Arab hijackers' who were blamed for what happened. Observe what was justified in the name of 9/11 alone in terms of Middle East invasions, mass surveillance and control that fulfilled the demands of the Project for the New American Century document published by the Sabbatian Neocons. What appear to be enemies are on the deep inside players on the same Sabbatian team. Israel and Arab 'royal' dictatorships are all ruled by Sabbatians and the recent peace agreements between Israel and Saudi Arabia, the United Arab Emirates (UAE) and others are only making formal what has always been the case behind the scenes. Palestinians who have been subjected to grotesque tyranny since Israel was bombed and terrorised into existence in 1948 have never stood a chance. Sabbatian-Frankists have controlled Israel (so the constant theme of violence and war which Sabbatians love) and they have controlled the Arab countries that Palestinians have looked to for real support that never comes. 'Royal families' of the Arab world in Saudi Arabia, Bahrain, UAE, etc., are all Sabbatians with allegiance to the aims of the cult and not what is best for their Arabic populations. They have stolen the oil and financial resources from their people by false claims to be 'royal dynasties' with a genetic right to rule and by employing vicious militaries to impose their will.

Satanic 'illumination'

The Satanist Jacob Frank formed an alliance in 1773 with two other Sabbatians, Mayer Amschel Rothschild (1744-1812), founder of the Rothschild banking dynasty, and Jesuit-educated fraudulent Jew, Adam Weishaupt, and this led to the formation of the Bavarian Illuminati, firstly under another name, in 1776. The Illuminati would

be the manipulating force behind the French Revolution (1789-1799) and was also involved in the American Revolution (1775-1783) before and after the Illuminati's official creation. Weishaupt would later become (in public) a Protestant Christian in archetypal Sabbatian style. I read that his name can be decoded as Adam-Weishaupt or 'the first man to lead those who know'. He wasn't a leader in the sense that he was a subordinate, but he did lead those below him in a crusade of transforming human society that still continues today. The theme was confirmed as early as 1785 when a horseman courier called Lanz was reported to be struck by lighting and extensive Illuminati documents were found in his saddlebags. They made the link to Weishaupt and detailed the plan for world takeover. Current events with 'Covid' fascism have been in the making for a very long time. Jacob Frank was jailed for 13 years by the Catholic Inquisition after his arrest in 1760 and on his release he headed for Frankfurt, Germany, home city and headquarters of the House of Rothschild where the alliance was struck with Mayer Amschel Rothschild and Weishaupt. Rothschild arranged for Frank to be given the title of Baron and he became a wealthy nobleman with a big following of Jews in Germany, the Austro-Hungarian Empire and other European countries. Most of them would have believed he was on their side.

The name 'Illuminati' came from the Zohar which is a body of works in the Jewish mystical 'bible' called the Kabbalah. 'Zohar' is the foundation of Sabbatian-Frankist belief and in Hebrew 'Zohar' means 'splendour', 'radiance', 'illuminated', and so we have 'Illuminati'. They claim to be the 'Illuminated Ones' from their knowledge systematically hidden from the human population and passed on through generations of carefully-chosen initiates in the global secret society network or Cult. Hidden knowledge includes an awareness of the Cult agenda for the world and the nature of our collective reality that I will explore later. Cult 'illumination' is symbolised by the torch held by the Statue of Liberty which was gifted to New York by French Freemasons in Paris who knew exactly what it represents. 'Liberty' symbolises the goddess worshipped in

Babylon as Queen Semiramis or Ishtar. The significance of this will become clear. Notice again the ubiquitous theme of inversion with the Statue of 'Liberty' really symbolising mass control (Fig 7). A mirror-image statute stands on an island in the River Seine in Paris from where New York Liberty originated (Fig 8). A large replica of the Liberty flame stands on top of the Pont de l'Alma tunnel in Paris where Princess Diana died in a Cult ritual described in *The Biggest Secret*. Lucifer 'the light bringer' is related to all this (and much more as we'll see) and 'Lucifer' is a central figure in Sabbatian-Frankism and its associated Satanism. Sabbatians reject the Jewish Torah, or Pentateuch, the 'five books of Moses' in the Old Testament known as Genesis, Exodus, Leviticus, Numbers, and Deuteronomy which are claimed by Judaism and Christianity to have been dictated by 'God' to Moses on Mount Sinai. Sabbatians say these do not apply to them and they seek to replace them with the Zohar to absorb Judaism and its followers into their inversion which is an expression of a much greater global inversion. They want to delete all religions and force humanity to worship a one-world religion – Sabbatian Satanism that also includes worship of the Earth goddess. Satanic themes are being more and more introduced into mainstream society and while Christianity is currently the foremost target for destruction the others are planned to follow.

Figure 7: The Cult goddess of Babylon disguised as the Statue of Liberty holding the flame of Lucifer the 'light bringer'.

Figure 8: Liberty's mirror image in Paris where the New York version originated.

Marx brothers

Rabbi Marvin Antelman connects the Illuminati to the Jacobins in *To Eliminate the Opiate* and Jacobins were the force behind the French Revolution. He links both to the Bund der Gerechten, or League of the Just, which was the network that inflicted communism/Marxism on the world. Antelman wrote:

> The original inner circle of the Bund der Gerechten consisted of born Catholics, Protestants and Jews [Sabbatian-Frankist infiltrators], and those representatives of respective subdivisions formulated schemes for the ultimate destruction of their faiths. The heretical Catholics laid plans which they felt would take a century or more for the ultimate destruction of the church; the apostate Jews for the ultimate destruction of the Jewish religion.

Sabbatian-created communism connects into this anti-religion agenda in that communism does not allow for the free practice of religion. The Sabbatian 'Bund' became the International Communist Party and Communist League and in 1848 'Marxism' was born with the Communist Manifesto of Sabbatian assets Karl Marx and Friedrich Engels. It is absolutely no coincidence that Marxism, just a different name for fascist and other centrally-controlled tyrannies, is being imposed worldwide as a result of the 'Covid' hoax and nor that Marxist/fascist China was the place where the hoax originated. The reason for this will become very clear in the chapter 'Covid: The calculated catastrophe'. The so-called 'Woke' mentality has hijacked

traditional beliefs of the political left and replaced them with far-right make-believe 'social justice' better known as Marxism. Woke will, however, be swallowed by its own perceived 'revolution' which is really the work of billionaires and billionaire corporations feigning being 'Woke'. Marxism is being touted by Wokers as a replacement for 'capitalism' when we don't have 'capitalism'. We have cartelism in which the market is stitched up by the very Cult billionaires and corporations bankrolling Woke. Billionaires love Marxism which keeps the people in servitude while they control from the top. Terminally naïve Wokers think they are 'changing the world' when it's the Cult that is doing the changing and when they have played their vital part and become surplus to requirements they, too, will be targeted. The Illuminati-Jacobins were behind the period known as 'The Terror' in the French Revolution in 1793 and 1794 when Jacobin Maximillian de Robespierre and his Orwellian 'Committee of Public Safety' killed 17,000 'enemies of the Revolution' who had once been 'friends of the Revolution'. Karl Marx (1818-1883), whose Sabbatian creed of Marxism has cost the lives of at least 100 million people, is a hero once again to Wokers who have been systematically kept ignorant of real history by their 'education' programming. As a result they now promote a Sabbatian 'Marxist' abomination destined at some point to consume them. Rabbi Antelman, who spent decades researching the Sabbatian plot, said of the League of the Just and Karl Marx:

> Contrary to popular opinion Karl Marx did not originate the Communist Manifesto. He was paid for his services by the League of the Just, which was known in its country of origin, Germany, as the Bund der Geaechteten.

Antelman said the text attributed to Marx was the work of other people and Marx 'was only repeating what others already said'. Marx was 'a hired hack – lackey of the wealthy Illuminists'. Marx famously said that religion was the 'opium of the people' (part of the Sabbatian plan to demonise religion) and Antelman called his books, *To Eliminate the Opiate*. Marx was born Jewish, but his family converted to Christianity (Sabbatian modus operandi) and he

attacked Jews, not least in his book, *A World Without Jews*. In doing so he supported the Sabbatian plan to destroy traditional Jewishness and Judaism which we are clearly seeing today with the vindictive targeting of orthodox Jews by the Sabbatian government of Israel over 'Covid' laws. I don't follow any religion and it has done much damage to the world over centuries and acted as a perceptual straightjacket. Renegade Minds, however, are always asking *why* something is being done. It doesn't matter if they agree or disagree with what is happening – *why* is it happening is the question. The 'why?' can be answered with regard to religion in that religions create interacting communities of believers when the Cult wants to dismantle all discourse, unity and interaction (see 'Covid' lockdowns) and the ultimate goal is to delete all religions for a one-world religion of Cult Satanism worshipping their 'god' of which more later. We see the same 'why?' with gun control in America. I don't have guns and don't want them, but why is the Cult seeking to disarm the population at the same time that law enforcement agencies are armed to their molars and why has every tyrant in history sought to disarm people before launching the final takeover? They include Hitler, Stalin, Pol Pot and Mao who followed confiscation with violent seizing of power. You know it's a Cult agenda by the people who immediately race to the microphones to exploit dead people in multiple shootings. Ultra-Zionist Cult lackey Senator Chuck Schumer was straight on the case after ten people were killed in Boulder, Colorado in March, 2121. Simple rule … if Schumer wants it the Cult wants it and the same with his ultra-Zionist mate the wild-eyed Senator Adam Schiff. At the same time they were calling for the disarmament of Americans, many of whom live a long way from a police response, Schumer, Schiff and the rest of these pampered clowns were sitting on Capitol Hill behind a razor-wired security fence protected by thousands of armed troops in addition to their own armed bodyguards. Mom and pop in an isolated home? They're just potential mass shooters.

Zion Mainframe

Sabbatian-Frankists and most importantly the Rothschilds were behind the creation of 'Zionism', a political movement that demanded a Jewish homeland in Israel as promised by Sabbatai Zevi. The very symbol of Israel comes from the German meaning of the name Rothschild. Dynasty founder Mayer Amschel Rothschild changed the family name from Bauer to Rothschild, or 'Red-Shield' in German, in deference to the six-pointed 'Star of David' hexagram displayed on the family's home in Frankfurt. The symbol later appeared on the flag of Israel after the Rothschilds were centrally involved in its creation. Hexagrams are not a uniquely Jewish symbol and are widely used in occult ('hidden') networks often as a symbol for Saturn (see my other books for why). Neither are Zionism and Jewishness interchangeable. Zionism is a political movement and philosophy and not a 'race' or a people. Many Jews oppose Zionism and many non-Jews, including US President Joe Biden, call themselves Zionists as does Israel-centric Donald Trump. America's support for the Israel government is pretty much a gimme with ultra-Zionist billionaires and corporations providing fantastic and dominant funding for both political parties. Former Congresswoman Cynthia McKinney has told how she was approached immediately she ran for office to 'sign the pledge' to Israel and confirm that she would always vote in that country's best interests. All American politicians are approached in this way. Anyone who refuses will get no support or funding from the enormous and all-powerful Zionist lobby that includes organisations like mega-lobby group AIPAC, the American Israel Public Affairs Committee. Trump's biggest funder was ultra-Zionist casino and media billionaire Sheldon Adelson while major funders of the Democratic Party include ultra-Zionist George Soros and ultra-Zionist financial and media mogul, Haim Saban. Some may reel back at the suggestion that Soros is an Israel-firster (Sabbatian-controlled Israel-firster), but Renegade Minds watch the actions not the words and everywhere Soros donates his billions the Sabbatian agenda benefits. In the spirit of Sabbatian inversion Soros pledged $1 billion for a new university network to promote 'liberal values and tackle intolerance'. He made the announcement during his annual speech

at the Cult-owned World Economic Forum in Davos, Switzerland, in January, 2020, after his 'harsh criticism' of 'authoritarian rulers' around the world. You can only laugh at such brazen mendacity. How *he* doesn't laugh is the mystery. Translated from the Orwellian 'liberal values and tackle intolerance' means teaching non-white people to hate white people and for white people to loathe themselves for being born white. The reason for that will become clear.

The 'Anti-Semitism' fraud

Zionists support the Jewish homeland in the land of Palestine which has been the Sabbatian-Rothschild goal for so long, but not for the benefit of Jews. Sabbatians and their global Anti-Semitism Industry have skewed public and political opinion to equate opposing the violent extremes of Zionism to be a blanket attack and condemnation of all Jewish people. Sabbatians and their global Anti-Semitism Industry have skewed public and political opinion to equate opposing the violent extremes of Zionism to be a blanket attack and condemnation of all Jewish people. This is nothing more than a Sabbatian protection racket to stop legitimate investigation and exposure of their agendas and activities. The official definition of 'anti-Semitism' has more recently been expanded to include criticism of Zionism – a *political movement* – and this was done to further stop exposure of Sabbatian infiltrators who created Zionism as we know it today in the 19th century. Renegade Minds will talk about these subjects when they know the shit that will come their way. People must decide if they want to know the truth or just cower in the corner in fear of what others will say. Sabbatians have been trying to label me as 'anti-Semitic' since the 1990s as I have uncovered more and more about their background and agendas. Useless, gutless, fraudulent 'journalists' then just repeat the smears without question and on the day I was writing this section a pair of unquestioning repeaters called Ben Quinn and Archie Bland (how appropriate) outright called me an 'anti-Semite' in the establishment propaganda sheet, the London *Guardian*, with no supporting evidence. The

Sabbatian Anti-Semitism Industry said so and who are they to question that? They wouldn't dare. Ironically 'Semitic' refers to a group of languages in the Middle East that are almost entirely Arabic. 'Anti-Semitism' becomes 'anti-Arab' which if the consequences of this misunderstanding were not so grave would be hilarious. Don't bother telling Quinn and Bland. I don't want to confuse them, bless 'em. One reason I am dubbed 'anti-Semitic' is that I wrote in the 1990s that Jewish operatives (Sabbatians) were heavily involved in the Russian Revolution when Sabbatians overthrew the Romanov dynasty. This apparently made me 'anti-Semitic'. Oh, really? Here is a section from *The Trigger*:

British journalist Robert Wilton confirmed these themes in his 1920 book *The Last Days of the Romanovs* when he studied official documents from the Russian government to identify the members of the Bolshevik ruling elite between 1917 and 1919. The Central Committee included 41 Jews among 62 members; the Council of the People's Commissars had 17 Jews out of 22 members; and 458 of the 556 most important Bolshevik positions between 1918 and 1919 were occupied by Jewish people. Only 17 were Russian. Then there were the 23 Jews among the 36 members of the vicious Cheka Soviet secret police established in 1917 who would soon appear all across the country.

Professor Robert Service of Oxford University, an expert on 20th century Russian history, found evidence that ['Jewish'] Leon Trotsky had sought to make sure that Jews were enrolled in the Red Army and were disproportionately represented in the Soviet civil bureaucracy that included the Cheka which performed mass arrests, imprisonment and executions of 'enemies of the people'. A US State Department Decimal File (861.00/5339) dated November 13th, 1918, names [Rothschild banking agent in America] Jacob Schiff and a list of ultra-Zionists as funders of the Russian Revolution leading to claims of a 'Jewish plot', but the key point missed by all is they were not 'Jews' – they were Sabbatian-Frankists.

Britain's Winston Churchill made the same error by mistake or otherwise. He wrote in a 1920 edition of the *Illustrated Sunday Herald* that those behind the Russian revolution were part of a 'worldwide conspiracy for the overthrow of civilisation and for the reconstitution of society on the basis of arrested development, of envious malevolence, and impossible equality' (see 'Woke' today because that has been created by the same network). Churchill said there was no need to exaggerate the part played in the creation of Bolshevism and in the actual bringing about of the Russian

Revolution 'by these international and for the most part atheistical Jews' ['atheistical Jews' = Sabbatians]. Churchill said it is certainly a very great one and probably outweighs all others: 'With the notable exception of Lenin, the majority of the leading figures are Jews.' He went on to describe, knowingly or not, the Sabbatian modus operandi of placing puppet leaders nominally in power while they control from the background:

> Moreover, the principal inspiration and driving power comes from the Jewish leaders. Thus Tchitcherin, a pure Russian, is eclipsed by his nominal subordinate, Litvinoff, and the influence of Russians like Bukharin or Lunacharski cannot be compared with the power of Trotsky, or of Zinovieff, the Dictator of the Red Citadel (Petrograd), or of Krassin or Radek – all Jews. In the Soviet institutions the predominance of Jews is even more astonishing. And the prominent, if not indeed the principal, part in the system of terrorism applied by the Extraordinary Commissions for Combatting Counter-Revolution has been taken by Jews, and in some notable cases by Jewesses.

What I said about seriously disproportionate involvement in the Russian Revolution by Jewish 'revolutionaries' (Sabbatians) is provable fact, but truth is no defence against the Sabbatian Anti-Semitism Industry, its repeater parrots like Quinn and Bland, and the now breathtaking network of so-called 'Woke' 'anti-hate' groups with interlocking leaderships and funding which have the role of discrediting and silencing anyone who gets too close to exposing the Sabbatians. We have seen 'truth is no defence' confirmed in legal judgements with the Saskatchewan Human Rights Commission in Canada decreeing this: 'Truthful statements can be presented in a manner that would meet the definition of hate speech, and not all truthful statements must be free from restriction.' Most 'anti-hate' activists, who are themselves consumed by hatred, are too stupid and ignorant of the world to know how they are being used. They are far too far up their own virtue-signalling arses and it's far too dark for them to see anything.

The 'revolution' game

The background and methods of the 'Russian' Revolution are straight from the Sabbatian playbook seen in the French Revolution

and endless others around the world that appear to start as a revolution of the people against tyrannical rule and end up with a regime change to more tyrannical rule overtly or covertly. Wars, terror attacks and regime overthrows follow the Sabbatian cult through history with its agents creating them as Problem-Reaction-Solutions to remove opposition on the road to world domination. Sabbatian dots connect the Rothschilds with the Illuminati, Jacobins of the French Revolution, the 'Bund' or League of the Just, the International Communist Party, Communist League and the Communist Manifesto of Karl Marx and Friedrich Engels that would lead to the Rothschild-funded Russian Revolution. The sequence comes under the heading of 'creative destruction' when you advance to your global goal by continually destroying the status quo to install a new status quo which you then also destroy. The two world wars come to mind. With each new status quo you move closer to your planned outcome. Wars and mass murder are to Sabbatians a collective blood sacrifice ritual. They are obsessed with death for many reasons and one is that death is an inversion of life. Satanists and Sabbatians are obsessed with death and often target churches and churchyards for their rituals. Inversion-obsessed Sabbatians explain the use of inverted symbolism including the *inverted* pentagram and *inverted* cross. The inversion of the cross has been related to targeting Christianity, but the cross was a religious symbol long before Christianity and its inversion is a statement about the Sabbatian mentality and goals more than any single religion.

Sabbatians operating in Germany were behind the rise of the occult-obsessed Nazis and the subsequent Jewish exodus from Germany and Europe to Palestine and the United States after World War Two. The Rothschild dynasty was at the forefront of this both as political manipulators and by funding the operation. Why would Sabbatians help to orchestrate the horrors inflicted on Jews by the Nazis and by Stalin after they organised the Russian Revolution? Sabbatians hate Jews and their religion, that's why. They pose as Jews and secure positions of control within Jewish society and play the 'anti-Semitism' card to protect themselves from exposure

through a global network of organisations answering to the Sabbatian-created-and-controlled globe-spanning intelligence network that involves a stunning web of military-intelligence operatives and operations for a tiny country of just nine million. Among them are Jewish assets who are not Sabbatians but have been convinced by them that what they are doing is for the good of Israel and the Jewish community to protect them from what they have been programmed since childhood to believe is a Jew-hating hostile world. The Jewish community is just a highly convenient cover to hide the true nature of Sabbatians. Anyone getting close to exposing their game is accused by Sabbatian place-people and gofers of 'anti-Semitism' and claiming that all Jews are part of a plot to take over the world. I am not saying that. I am saying that Sabbatians – the *real* Jew-haters – have infiltrated the Jewish community to use them both as a cover and an 'anti-Semitic' defence against exposure. Thus we have the Anti-Semitism Industry targeted researchers in this way and most Jewish people think this is justified and genuine. They don't know that their 'Jewish' leaders and institutions of state, intelligence and military are not controlled by Jews at all, but cultists and stooges of Sabbatian-Frankism. I once added my name to a pro-Jewish freedom petition online and the next time I looked my name was gone and text had been added to the petition blurb to attack me as an 'anti-Semite' such is the scale of perceptual programming.

Moving on America

I tell the story in *The Trigger* and a chapter called 'Atlantic Crossing' how particularly after Israel was established the Sabbatians moved in on the United States and eventually grasped control of government administration, the political system via both Democrats and Republicans, the intelligence community like the CIA and National Security Agency (NSA), the Pentagon and mass media. Through this seriously compartmentalised network Sabbatians and their operatives in Mossad, Israeli Defense Forces (IDF) and US agencies pulled off 9/11 and blamed it on 19 'Al-Qaeda hijackers' dominated by men from, or connected to, Sabbatian-ruled Saudi

Arabia. The '19' were not even on the planes let alone flew those big passenger jets into buildings while being largely incompetent at piloting one-engine light aircraft. 'Hijacker' Hani Hanjour who is said to have flown American Airlines Flight 77 into the Pentagon with a turn and manoeuvre most professional pilots said they would have struggled to do was banned from renting a small plane by instructors at the Freeway Airport in Bowie, Maryland, just *six weeks* earlier on the grounds that he was an incompetent pilot. The Jewish population of the world is just 0.2 percent with even that almost entirely concentrated in Israel (75 percent Jewish) and the United States (around two percent). This two percent and globally 0.2 percent refers to *Jewish* people and not Sabbatian interlopers who are a fraction of that fraction. What a sobering thought when you think of the fantastic influence on world affairs of tiny Israel and that the Project for the New America Century (PNAC) which laid out the blueprint in September, 2000, for America's war on terror and regime change wars in Iraq, Libya and Syria was founded and dominated by Sabbatians known as 'Neocons'. The document conceded that this plan would not be supported politically or publicly without a major attack on American soil and a Problem-Reaction-Solution excuse to send troops to war across the Middle East. Sabbatian Neocons said:

> ... [The] process of transformation ... [war and regime change] ... is likely to be a long one, absent some catastrophic and catalysing event – like a new Pearl Harbor.

Four months later many of those who produced that document came to power with their inane puppet George Bush from the long-time Sabbatian Bush family. They included Sabbatian Dick Cheney who was officially vice-president, but really de-facto president for the entirety of the 'Bush' government. Nine months after the 'Bush' inauguration came what Bush called at the time 'the Pearl Harbor of the 21st century' and with typical Sabbatian timing and symbolism 2001 was the 60th anniversary of the attack in 1941 by the Japanese Air Force on Pearl Harbor, Hawaii, which allowed President Franklin Delano Roosevelt to take the United States into a Sabbatian-

instigated Second World War that he said in his election campaign that he never would. The evidence is overwhelming that Roosevelt and his military and intelligence networks knew the attack was coming and did nothing to stop it, but they did make sure that America's most essential naval ships were not in Hawaii at the time. Three thousand Americans died in the Pearl Harbor attacks as they did on September 11th. By the 9/11 year of 2001 Sabbatians had widely infiltrated the US government, military and intelligence operations and used their compartmentalised assets to pull off the 'Al-Qaeda' attacks. If you read *The Trigger* it will blow your mind to see the utterly staggering concentration of 'Jewish' operatives (Sabbatian infiltrators) in essential positions of political, security, legal, law enforcement, financial and business power before, during, and after the attacks to make them happen, carry them out, and then cover their tracks – and I do mean *staggering* when you think of that 0.2 percent of the world population and two percent of Americans which are Jewish while Sabbatian infiltrators are a fraction of that. A central foundation of the 9/11 conspiracy was the hijacking of government, military, Air Force and intelligence computer systems in real time through 'back-door' access made possible by Israeli (Sabbatian) 'cyber security' software. Sabbatian-controlled Israel is on the way to rivalling Silicon Valley for domination of cyberspace and is becoming the dominant force in cyber-security which gives them access to entire computer systems and their passcodes across the world. Then add to this that Zionists head (officially) Silicon Valley giants like Google (Larry Page and Sergey Brin), Google-owned YouTube (Susan Wojcicki), Facebook (Mark Zuckerberg and Sheryl Sandberg), and Apple (Chairman Arthur D. Levinson), and that ultra-Zionist hedge fund billionaire Paul Singer has a $1 billion stake in Twitter which is only nominally headed by 'CEO' pothead Jack Dorsey. As cable news host Tucker Carlson said of Dorsey: 'There used to be debate in the medical community whether dropping a ton of acid had permanent effects and I think that debate has now ended.' Carlson made the comment after Dorsey told a hearing on Capitol Hill (if you cut through his bullshit) that he

believed in free speech so long as he got to decide what you can hear and see. These 'big names' of Silicon Valley are only front men and women for the Global Cult, not least the Sabbatians, who are the true controllers of these corporations. Does anyone still wonder why these same people and companies have been ferociously censoring and banning people (like me) for exposing any aspect of the Cult agenda and especially the truth about the 'Covid' hoax which Sabbatians have orchestrated?

The Jeffrey Epstein paedophile ring was a Sabbatian operation. He was officially 'Jewish' but he was a Sabbatian and women abused by the ring have told me about the high number of 'Jewish' people involved. The Epstein horror has Sabbatian written all over it and matches perfectly their modus operandi and obsession with sex and ritual. Epstein was running a Sabbatian blackmail ring in which famous people with political and other influence were provided with young girls for sex while everything was being filmed and recorded on hidden cameras and microphones at his New York house, Caribbean island and other properties. Epstein survivors have described this surveillance system to me and some have gone public. Once the famous politician or other figure knew he or she was on video they tended to do whatever they were told. Here we go again …when you've got them by the balls their hearts and minds will follow. Sabbatians use this blackmail technique on a wide scale across the world to entrap politicians and others they need to act as demanded. Epstein's private plane, the infamous 'Lolita Express', had many well-known passengers including Bill Clinton while Bill Gates has flown on an Epstein plane and met with him four years after Epstein had been jailed for paedophilia. They subsequently met many times at Epstein's home in New York according to a witness who was there. Epstein's infamous side-kick was Ghislaine Maxwell, daughter of Mossad agent and ultra-Zionist mega-crooked British businessman, Bob Maxwell, who at one time owned the *Daily Mirror* newspaper. Maxwell was murdered at sea on his boat in 1991 by Sabbatian-controlled Mossad when he became a liability with his

business empire collapsing as a former Mossad operative has confirmed (see *The Trigger*).

Money, money, money, funny money …

Before I come to the Sabbatian connection with the last three US presidents I will lay out the crucial importance to Sabbatians of controlling banking and finance. Sabbatian Mayer Amschel Rothschild set out to dominate this arena in his family's quest for total global control. What is freedom? It is, in effect, choice. The more choices you have the freer you are and the fewer your choices the more you are enslaved. In the global structure created over centuries by Sabbatians the biggest decider and restrictor of choice is … money. Across the world if you ask people what they would like to do with their lives and why they are not doing that they will reply 'I don't have the money'. This is the idea. A global elite of multi-billionaires are described as 'greedy' and that is true on one level; but control of money – who has it and who doesn't – is not primarily about greed. It's about control. Sabbatians have seized ever more control of finance and sucked the wealth of the world out of the hands of the population. We talk now, after all, about the 'One-percent' and even then the wealthiest are a lot fewer even than that. This has been made possible by a money scam so outrageous and so vast it could rightly be called the scam of scams founded on creating 'money' out of nothing and 'loaning' that with interest to the population. Money out of nothing is called 'credit'. Sabbatians have asserted control over governments and banking ever more completely through the centuries and secured financial laws that allow banks to lend hugely more than they have on deposit in a confidence trick known as fractional reserve lending. Imagine if you could lend money that doesn't exist and charge the recipient interest for doing so. You would end up in jail. Bankers by contrast end up in mansions, private jets, Malibu and Monaco.

Banks are only required to keep a fraction of their deposits and wealth in their vaults and they are allowed to lend 'money' they don't have called 'credit. Go into a bank for a loan and if you succeed

the banker will not move any real wealth into your account. They will type into your account the amount of the agreed 'loan' – say £100,000. This is not wealth that really exists; it is non-existent, fresh-air, created-out-of-nothing 'credit' which has never, does not, and will never exist except in theory. Credit is backed by nothing except wind and only has buying power because people think that it has buying power and accept it in return for property, goods and services. I have described this situation as like those cartoon characters you see chasing each other and when they run over the edge of a cliff they keep running forward on fresh air until one of them looks down, realises what's happened, and they all crash into the ravine. The whole foundation of the Sabbatian financial system is to stop people looking down except for periodic moments when they want to crash the system (as in 2008 and 2020 ongoing) and reap the rewards from all the property, businesses and wealth their borrowers had signed over as 'collateral' in return for a 'loan' of fresh air. Most people think that money is somehow created by governments when it comes into existence from the start as a debt through banks 'lending' illusory money called credit. Yes, the very currency of exchange is a *debt* from day one issued as an interest-bearing loan. Why don't governments create money interest-free and lend it to their people interest-free? Governments are controlled by Sabbatians and the financial system is controlled by Sabbatians for whom interest-free money would be a nightmare come true. Sabbatians underpin their financial domination through their global network of central banks, including the privately-owned US Federal Reserve and Britain's Bank of England, and this is orchestrated by a privately-owned central bank coordination body called the Bank for International Settlements in Basle, Switzerland, created by the usual suspects including the Rockefellers and Rothschilds. Central bank chiefs don't answer to governments or the people. They answer to the Bank for International Settlements or, in other words, the Global Cult which is dominated today by Sabbatians.

Built-in disaster

There are so many constituent scams within the overall banking scam. When you take out a loan of thin-air credit only the amount of that loan is theoretically brought into circulation to add to the amount in circulation; but you are paying back the principle plus interest. The additional interest is not created and this means that with every 'loan' there is a shortfall in the money in circulation between what is borrowed and what has to be paid back. There is never even close to enough money in circulation to repay all outstanding public and private debt including interest. Coldly weaved in the very fabric of the system is the certainty that some will lose their homes, businesses and possessions to the banking 'lender'. This is less obvious in times of 'boom' when the amount of money in circulation (and the debt) is expanding through more people wanting and getting loans. When a downturn comes and the money supply contracts it becomes painfully obvious that there is not enough money to service all debt and interest. This is less obvious in times of 'boom' when the amount of money in circulation (and the debt) is expanding through more people wanting and getting loans. When a downturn comes and the money supply contracts and it becomes painfully obvious – as in 2008 and currently – that there is not enough money to service all debt and interest. Sabbatian banksters have been leading the human population through a calculated series of booms (more debt incurred) and busts (when the debt can't be repaid and the banks get the debtor's tangible wealth in exchange for non-existent 'credit'). With each 'bust' Sabbatian bankers have absorbed more of the world's tangible wealth and we end up with the One-percent. Governments are in bankruptcy levels of debt to the same system and are therefore owned by a system they do not control. The Federal Reserve, 'America's central bank', is privately-owned and American presidents only nominally appoint its chairman or woman to maintain the illusion that it's an arm of government. It's not. The 'Fed' is a cartel of private banks which handed billions to its associates and friends after the crash of 2008 and has been Sabbatian-controlled since it was manipulated into being in 1913 through the covert trickery of Rothschild banking agents Jacob Schiff and Paul

Warburg, and the Sabbatian Rockefeller family. Somehow from a Jewish population of two-percent and globally 0.2 percent (Sabbatian interlopers remember are far smaller) ultra-Zionists headed the Federal Reserve for 31 years between 1987 and 2018 in the form of Alan Greenspan, Bernard Bernanke and Janet Yellen (now Biden's Treasury Secretary) with Yellen's deputy chairman a Israeli-American duel citizen and ultra-Zionist Stanley Fischer, a former governor of the Bank of Israel. Ultra-Zionist Fed chiefs spanned the presidencies of Ronald Reagan ('Republican'), Father George Bush ('Republican'), Bill Clinton ('Democrat'), Boy George Bush ('Republican') and Barack Obama ('Democrat'). We should really add the pre-Greenspan chairman, Paul Adolph Volcker, 'appointed' by Jimmy Carter ('Democrat') who ran the Fed between 1979 and 1987 during the Carter and Reagan administrations before Greenspan took over. Volcker was a long-time associate and business partner of the Rothschilds. No matter what the 'party' officially in power the United States economy was directed by the same force. Here are members of the Obama, Trump and Biden administrations and see if you can make out a common theme.

Barack Obama ('Democrat')

Ultra-Zionists Robert Rubin, Larry Summers, and Timothy Geithner ran the US Treasury in the Clinton administration and two of them reappeared with Obama. Ultra-Zionist Fed chairman Alan Greenspan had manipulated the crash of 2008 through deregulation and jumped ship just before the disaster to make way for ultra-Zionist Bernard Bernanke to hand out trillions to Sabbatian 'too big to fail' banks and businesses, including the ubiquitous ultra-Zionist Goldman Sachs which has an ongoing staff revolving door operation between itself and major financial positions in government worldwide. Obama inherited the fallout of the crash when he took office in January, 2009, and fortunately he had the support of his ultra-Zionist White House Chief of Staff Rahm Emmanuel, son of a terrorist who helped to bomb Israel into being in 1948, and his ultra-Zionist senior adviser David Axelrod, chief strategist in Obama's two

successful presidential campaigns. Emmanuel, later mayor of Chicago and former senior fundraiser and strategist for Bill Clinton, is an example of the Sabbatian policy after Israel was established of migrating insider families to America so their children would be born American citizens. 'Obama' chose this financial team throughout his administration to respond to the Sabbatian-instigated crisis:

Timothy Geithner (ultra-Zionist) Treasury Secretary; Jacob J. Lew, Treasury Secretary; Larry Summers (ultra-Zionist), director of the White House National Economic Council; Paul Adolph Volcker (Rothschild business partner), chairman of the Economic Recovery Advisory Board; Peter Orszag (ultra-Zionist), director of the Office of Management and Budget overseeing all government spending; Penny Pritzker (ultra-Zionist), Commerce Secretary; Jared Bernstein (ultra-Zionist), chief economist and economic policy adviser to Vice President Joe Biden; Mary Schapiro (ultra-Zionist), chair of the Securities and Exchange Commission (SEC); Gary Gensler (ultra-Zionist), chairman of the Commodity Futures Trading Commission (CFTC); Sheila Bair (ultra-Zionist), chair of the Federal Deposit Insurance Corporation (FDIC); Karen Mills (ultra-Zionist), head of the Small Business Administration (SBA); Kenneth Feinberg (ultra-Zionist), Special Master for Executive [bail-out] Compensation. Feinberg would be appointed to oversee compensation (with strings) to 9/11 victims and families in a campaign to stop them having their day in court to question the official story. At the same time ultra-Zionist Bernard Bernanke was chairman of the Federal Reserve and these are only some of the ultra-Zionists with allegiance to Sabbatian-controlled Israel in the Obama government. Obama's biggest corporate donor was ultra-Zionist Goldman Sachs which had employed many in his administration.

Donald Trump ('Republican')

Trump claimed to be an outsider (he wasn't) who had come to 'drain the swamp'. He embarked on this goal by immediately appointing ultra-Zionist Steve Mnuchin, a Goldman Sachs employee for 17

years, as his Treasury Secretary. Others included Gary Cohn (ultra-Zionist), chief operating officer of Goldman Sachs, his first Director of the National Economic Council and chief economic adviser, who was later replaced by Larry Kudlow (ultra-Zionist). Trump's senior adviser throughout his four years in the White House was his sinister son-in-law Jared Kushner, a life-long friend of Israel Prime Minister Benjamin Netanyahu. Kushner is the son of a convicted crook who was pardoned by Trump in his last days in office. Other ultra-Zionists in the Trump administration included: Stephen Miller, Senior Policy Adviser; Avrahm Berkowitz, Deputy Adviser to Trump and his Senior Adviser Jared Kushner; Ivanka Trump, Adviser to the President, who converted to Judaism when she married Jared Kushner; David Friedman, Trump lawyer and Ambassador to Israel; Jason Greenblatt, Trump Organization executive vice president and chief legal officer, who was made Special Representative for International Negotiations and the Israeli-Palestinian Conflict; Rod Rosenstein, Deputy Attorney General; Elliot Abrams, Special Representative for Venezuela, then Iran; John Eisenberg, National Security Council Legal Adviser and Deputy Council to the President for National Security Affairs; Anne Neuberger, Deputy National Manager, National Security Agency; Ezra Cohen-Watnick, Acting Under Secretary of Defense for Intelligence; Elan Carr, Special Envoy to monitor and combat anti-Semitism; Len Khodorkovsky, Deputy Special Envoy to monitor and combat anti-Semitism; Reed Cordish, Assistant to the President, Intragovernmental and Technology Initiatives. Trump Vice President Mike Pence and Secretary of State Mike Pompeo, both Christian Zionists, were also vehement supporters of Israel and its goals and ambitions.

Donald 'free-speech believer' Trump pardoned a number of financial and violent criminals while ignoring calls to pardon Julian Assange and Edward Snowden whose crimes are revealing highly relevant information about government manipulation and corruption and the widespread illegal surveillance of the American people by US 'security' agencies. It's so good to know that Trump is on the side of freedom and justice and not mega-criminals with

allegiance to Sabbatian-controlled Israel. These included a pardon for Israeli spy Jonathan Pollard who was jailed for life in 1987 under the Espionage Act. Aviem Sella, the Mossad agent who recruited Pollard, was also pardoned by Trump while Assange sat in jail and Snowden remained in exile in Russia. Sella had 'fled' (was helped to escape) to Israel in 1987 and was never extradited despite being charged under the Espionage Act. A Trump White House statement said that Sella's clemency had been 'supported by Benjamin Netanyahu, Ron Dermer, Israel's US Ambassador, David Friedman, US Ambassador to Israel and Miriam Adelson, wife of leading Trump donor Sheldon Adelson who died shortly before. Other friends of Jared Kushner were pardoned along with Sholom Weiss who was believed to be serving the longest-ever white-collar prison sentence of more than 800 years in 2000. The sentence was commuted of Ponzi-schemer Eliyahu Weinstein who defrauded Jews and others out of $200 million. I did mention that Assange and Snowden were ignored, right? Trump gave Sabbatians almost everything they asked for in military and political support, moving the US Embassy from Tel Aviv to Jerusalem with its critical symbolic and literal implications for Palestinian statehood, and the 'deal of the Century' designed by Jared Kushner and David Friedman which gave the Sabbatian Israeli government the green light to substantially expand its already widespread program of building illegal Jewish-only settlements in the occupied land of the West Bank. This made a two-state 'solution' impossible by seizing all the land of a potential Palestinian homeland and that had been the plan since 1948 and then 1967 when the Arab-controlled Gaza Strip, West Bank, Sinai Peninsula and Syrian Golan Heights were occupied by Israel. All the talks about talks and road maps and delays have been buying time until the West Bank was physically occupied by Israeli real estate. Trump would have to be a monumentally ill-informed idiot not to see that this was the plan he was helping to complete. The Trump administration was in so many ways the Kushner administration which means the Netanyahu administration which means the Sabbatian administration. I understand why many opposing Cult fascism in all its forms gravitated to Trump, but he

was a crucial part of the Sabbatian plan and I will deal with this in the next chapter.

Joe Biden ('Democrat')

A barely cognitive Joe Biden took over the presidency in January, 2021, along with his fellow empty shell, Vice-President Kamala Harris, as the latest Sabbatian gofers to enter the White House. Names on the door may have changed and the 'party' – the force behind them remained the same as Zionists were appointed to a stream of pivotal areas relating to Sabbatian plans and policy. They included: Janet Yellen, Treasury Secretary, former head of the Federal Reserve, and still another ultra-Zionist running the US Treasury after Mnuchin (Trump), Lew and Geithner (Obama), and Summers and Rubin (Clinton); Anthony Blinken, Secretary of State; Wendy Sherman, Deputy Secretary of State (so that's 'Biden's' Sabbatian foreign policy sorted); Jeff Zients, White House coronavirus coordinator; Rochelle Walensky, head of the Centers for Disease Control; Rachel Levine, transgender deputy health secretary (that's 'Covid' hoax policy under control); Merrick Garland, Attorney General; Alejandro Mayorkas, Secretary of Homeland Security; Cass Sunstein, Homeland Security with responsibility for new immigration laws; Avril Haines, Director of National Intelligence; Anne Neuberger, National Security Agency cybersecurity director (note, cybersecurity); David Cohen, CIA Deputy Director; Ronald Klain, Biden's Chief of Staff (see Rahm Emanuel); Eric Lander, a 'leading geneticist', Office of Science and Technology Policy director (see Smart Grid, synthetic biology agenda); Jessica Rosenworcel, acting head of the Federal Communications Commission (FCC) which controls Smart Grid technology policy and electromagnetic communication systems including 5G. How can it be that so many pivotal positions are held by two-percent of the American population and 0.2 percent of the world population administration after administration no matter who is the president and what is the party? It's a coincidence? Of course it's not and this is why Sabbatians have built their colossal global web of interlocking 'anti-

hate' hate groups to condemn anyone who asks these glaring questions as an 'anti-Semite'. The way that Jewish people horrifically abused in Sabbatian-backed Nazi Germany are exploited to this end is stomach-turning and disgusting beyond words.

Political fusion

Sabbatian manipulation has reversed the roles of Republicans and Democrats and the same has happened in Britain with the Conservative and Labour Parties. Republicans and Conservatives were always labelled the 'right' and Democrats and Labour the 'left', but look at the policy positions now and the Democrat-Labour 'left' has moved further to the 'right' than Republicans and Conservatives under the banner of 'Woke', the Cult-created far-right tyranny. Where once the Democrat-Labour 'left' defended free speech and human rights they now seek to delete them and as I said earlier despite the 'Covid' fascism of the Jackboot Johnson Conservative government in the UK the Labour Party of leader Keir Starmer demanded even more extreme measures. The Labour Party has been very publicly absorbed by Sabbatians after a political and media onslaught against the previous leader, the weak and inept Jeremy Corbyn, over made-up allegations of 'anti-Semitism' both by him and his party. The plan was clear with this 'anti-Semite' propaganda and what was required in response was a swift and decisive 'fuck off' from Corbyn and a statement to expose the Anti-Semitism Industry (Sabbatian) attempt to silence Labour criticism of the Israeli government (Sabbatians) and purge the party of all dissent against the extremes of ultra-Zionism (Sabbatians). Instead Corbyn and his party fell to their knees and appeased the abusers which, by definition, is impossible. Appeasing one demand leads only to a new demand to be appeased until takeover is complete. Like I say – 'fuck off' would have been a much more effective policy and I have used it myself with great effect over the years when Sabbatians are on my case which is most of the time. I consider that fact a great compliment, by the way. The outcome of the Labour Party capitulation is that we now have a Sabbatian-controlled

Conservative Party 'opposed' by a Sabbatian-controlled Labour Party in a one-party Sabbatian state that hurtles towards the extremes of tyranny (the Sabbatian cult agenda). In America the situation is the same. Labour's Keir Starmer spends his days on his knees with his tongue out pointing to Tel Aviv, or I guess now Jerusalem, while Boris Johnson has an 'anti-Semitism czar' in the form of former Labour MP John Mann who keeps Starmer company on his prayer mat.

Sabbatian influence can be seen in Jewish members of the Labour Party who have been ejected for criticism of Israel including those from families that suffered in Nazi Germany. Sabbatians despise real Jewish people and target them even more harshly because it is so much more difficult to dub them 'anti-Semitic' although in their desperation they do try.

CHAPTER THREE

The Pushbacker sting

Until you realize how easy it is for your mind to be manipulated, you remain the puppet of someone else's game
Evita Ochel

I will use the presidencies of Trump and Biden to show how the manipulation of the one-party state plays out behind the illusion of political choice across the world. No two presidencies could – on the face of it – be more different and apparently at odds in terms of direction and policy.

A Renegade Mind sees beyond the obvious and focuses on outcomes and consequences and not image, words and waffle. The Cult embarked on a campaign to divide America between those who blindly support its agenda (the mentality known as 'Woke') and those who are pushing back on where the Cult and its Sabbatians want to go. This presents infinite possibilities for dividing and ruling the population by setting them at war with each other and allows a perceptual ring fence of demonisation to encircle the Pushbackers in a modern version of the Little Big Horn in 1876 when American cavalry led by Lieutenant Colonel George Custer were drawn into a trap, surrounded and killed by Native American tribes defending their land of thousands of years from being seized by the government. In this modern version the roles are reversed and it's those defending themselves from the Sabbatian government who are surrounded and the government that's seeking to destroy them. This trap was set years ago and to explain how we must return to 2016

and the emergence of Donald Trump as a candidate to be President of the United States. He set out to overcome the best part of 20 other candidates in the Republican Party before and during the primaries and was not considered by many in those early stages to have a prayer of living in the White House. The Republican Party was said to have great reservations about Trump and yet somehow he won the nomination. When you know how American politics works – politics in general – there is no way that Trump could have become the party's candidate unless the Sabbatian-controlled 'Neocons' that run the Republican Party wanted that to happen. We saw the proof in emails and documents made public by WikiLeaks that the Democratic Party hierarchy, or Democons, systematically undermined the campaign of Bernie Sanders to make sure that Sabbatian gofer Hillary Clinton won the nomination to be their presidential candidate. If the Democons could do that then the Neocons in the Republican Party could have derailed Trump in the same way. But they didn't and at that stage I began to conclude that Trump could well be the one chosen to be president. If that was the case the 'why' was pretty clear to see – the goal of dividing America between Cult agenda-supporting Wokers and Pushbackers who gravitated to Trump because he was telling them what they wanted to hear. His constituency of support had been increasingly ignored and voiceless for decades and profoundly through the eight years of Sabbatian puppet Barack Obama. Now here was someone speaking their language of pulling back from the incessant globalisation of political and economic power, the exporting of American jobs to China and elsewhere by 'American' (Sabbatian) corporations, the deletion of free speech, and the mass immigration policies that had further devastated job opportunities for the urban working class of all races and the once American heartlands of the Midwest.

Beware the forked tongue

Those people collectively sighed with relief that at last a political leader was apparently on their side, but another trait of the Renegade Mind is that you look even harder at people telling you

what you want to hear than those who are telling you otherwise. Obviously as I said earlier people wish what they want to hear to be true and genuine and they are much more likely to believe that than someone saying what they don't want to here and don't want to be true. Sales people are taught to be skilled in eliciting by calculated questioning what their customers want to hear and repeating that back to them as their own opinion to get their targets to like and trust them. Assets of the Cult are also sales people in the sense of selling perception. To read Cult manipulation you have to play the long and expanded game and not fall for the Vaudeville show of party politics. Both American parties are vehicles for the Cult and they exploit them in different ways depending on what the agenda requires at that moment. Trump and the Republicans were used to be the focus of dividing America and isolating Pushbackers to open the way for a Biden presidency to become the most extreme in American history by advancing the full-blown Woke (Cult) agenda with the aim of destroying and silencing Pushbackers now labelled Nazi Trump supporters and white supremacists.

Sabbatians wanted Trump in office for the reasons described by ultra-Zionist Saul Alinsky (1909-1972) who was promoting the Woke philosophy through 'community organising' long before anyone had heard of it. In those days it still went by its traditional name of Marxism. The reason for the manipulated Trump phenomenon was laid out in Alinsky's 1971 book, *Rules for Radicals*, which was his blueprint for overthrowing democratic and other regimes and replacing them with Sabbatian Marxism. Not surprisingly his to-do list was evident in the Sabbatian French and Russian 'Revolutions' and that in China which will become very relevant in the next chapter about the 'Covid' hoax. Among Alinsky's followers have been the deeply corrupt Barack Obama, House Speaker Nancy Pelosi and Hillary Clinton who described him as a 'hero'. All three are Sabbatian stooges with Pelosi personifying the arrogant corrupt idiocy that so widely fronts up for the Cult inner core. Predictably as a Sabbatian advocate of the 'light-bringer' Alinsky features Lucifer on the dedication page of his book as the original radical who gained

his own kingdom ('Earth' as we shall see). One of Alinsky's golden radical rules was to pick an individual and focus all attention, hatred and blame on them and not to target faceless bureaucracies and corporations. *Rules for Radicals* is really a Sabbatian handbook with its contents repeatedly employed all over the world for centuries and why wouldn't Sabbatians bring to power their designer-villain to be used as the individual on which all attention, hatred and blame was bestowed? This is what they did and the only question for me is how much Trump knew that and how much he was manipulated. A bit of both, I suspect. This was Alinsky's Trump technique from a man who died in 1972. The technique has spanned history:

Pick the target, freeze it, personalize it, polarize it. Don't try to attack abstract corporations or bureaucracies. Identify a responsible individual. Ignore attempts to shift or spread the blame.

From the moment Trump came to illusory power everything was about him. It wasn't about Republican policy or opinion, but all about Trump. Everything he did was presented in negative, derogatory and abusive terms by the Sabbatian-dominated media led by Cult operations such as CNN, MSNBC, *The New York Times* and the Jeff Bezos-owned *Washington Post* – 'Pick the target, freeze it, personalize it, polarize it.' Trump was turned into a demon to be vilified by those who hated him and a demi-god loved by those who worshipped him. This, in turn, had his supporters, too, presented as equally demonic in preparation for the punchline later down the line when Biden was about to take office. It was here's a Trump, there's a Trump, everywhere a Trump, Trump. Virtually every news story or happening was filtered through the lens of 'The Donald'. You loved him or hated him and which one you chose was said to define you as Satan's spawn or a paragon of virtue. Even supporting some Trump policies or statements and not others was enough for an assault on your character. No shades of grey were or are allowed. Everything is black and white (literally and figuratively). A Californian I knew had her head utterly scrambled by her hatred for Trump while telling people they should love each other. She was so totally consumed by

Trump Derangement Syndrome as it became to be known that this glaring contradiction would never have occurred to her. By definition anyone who criticised Trump or praised his opponents was a hero and this lady described Joe Biden as 'a kind, honest gentleman' when he's a provable liar, mega-crook and vicious piece of work to boot. Sabbatians had indeed divided America using Trump as the fall-guy and all along the clock was ticking on the consequences for his supporters.

In hock to his masters

Trump gave Sabbatians via Israel almost everything they wanted in his four years. Ask and you shall receive was the dynamic between himself and Benjamin Netanyahu orchestrated by Trump's ultra-Zionist son-in-law Jared Kushner, his ultra-Zionist Ambassador to Israel, David Friedman, and ultra-Zionist 'Israel adviser', Jason Greenblatt. The last two were central to the running and protecting from collapse of his business empire, the Trump Organisation, and colossal business failures made him forever beholding to Sabbatian networks that bailed him out. By the start of the 1990s Trump owed $4 billion to banks that he couldn't pay and almost $1billion of that was down to him personally and not his companies. This mega-disaster was the result of building two new casinos in Atlantic City and buying the enormous Taj Mahal operation which led to crippling debt payments. He had borrowed fantastic sums from 72 banks with major Sabbatian connections and although the scale of debt should have had him living in a tent alongside the highway they never foreclosed. A plan was devised to lift Trump from the mire by BT Securities Corporation and Rothschild Inc. and the case was handled by Wilber Ross who had worked for the Rothschilds for 27 years. Ross would be named US Commerce Secretary after Trump's election. Another crucial figure in saving Trump was ultra-Zionist 'investor' Carl Icahn who bought the Taj Mahal casino. Icahn was made special economic adviser on financial regulation in the Trump administration. He didn't stay long but still managed to find time to make a tidy sum of a reported $31.3 million when he sold his

holdings affected by the price of steel three days before Trump imposed a 235 percent tariff on steel imports. What amazing bits of luck these people have. Trump and Sabbatian operatives have long had a close association and his mentor and legal adviser from the early 1970s until 1986 was the dark and genetically corrupt ultra-Zionist Roy Cohn who was chief counsel to Senator Joseph McCarthy's 'communist' witch-hunt in the 1950s. *Esquire* magazine published an article about Cohn with the headline 'Don't mess with Roy Cohn'. He was described as the most feared lawyer in New York and 'a ruthless master of dirty tricks ... [with] ... more than one Mafia Don on speed dial'. Cohn's influence, contacts, support and protection made Trump a front man for Sabbatians in New York with their connections to one of Cohn's many criminal employers, the 'Russian' Sabbatian Mafia. Israel-centric media mogul Rupert Murdoch was introduced to Trump by Cohn and they started a long friendship. Cohn died in 1986 weeks after being disbarred for unethical conduct by the Appellate Division of the New York State Supreme Court. The wheels of justice do indeed run slow given the length of Cohn's crooked career.

QAnon-sense

We are asked to believe that Donald Trump with his fundamental connections to Sabbatian networks and operatives has been leading the fight to stop the Sabbatian agenda for the fascistic control of America and the world. Sure he has. A man entrapped during his years in the White House by Sabbatian operatives and whose biggest financial donor was casino billionaire Sheldon Adelson who was Sabbatian to his DNA?? Oh, do come on. Trump has been used to divide America and isolate Pushbackers on the Cult agenda under the heading of 'Trump supporters', 'insurrectionists' and 'white supremacists'. The US Intelligence/Mossad Psyop or psychological operation known as QAnon emerged during the Trump years as a central pillar in the Sabbatian campaign to lead Pushbackers into the trap set by those that wished to destroy them. I knew from the start that QAnon was a scam because I had seen the same scenario many

times before over 30 years under different names and I had written about one in particular in the books. 'Not again' was my reaction when QAnon came to the fore. The same script is pulled out every few years and a new name added to the letterhead. The story always takes the same form: 'Insiders' or 'the good guys' in the government-intelligence-military 'Deep State' apparatus were going to instigate mass arrests of the 'bad guys' which would include the Rockefellers, Rothschilds, Barack Obama, Hillary Clinton, George Soros, etc., etc. Dates are given for when the 'good guys' are going to move in, but the dates pass without incident and new dates are given which pass without incident. The central message to Pushbackers in each case is that they don't have to do anything because there is 'a plan' and it is all going to be sorted by the 'good guys' on the inside. 'Trust the plan' was a QAnon mantra when the only plan was to misdirect Pushbackers into putting their trust in a Psyop they believed to be real. Beware, beware, those who tell you what you want to hear and always check it out. Right up to Biden's inauguration QAnon was still claiming that 'the Storm' was coming and Trump would stay on as president when Biden and his cronies were arrested and jailed. It was never going to happen and of course it didn't, but what did happen as a result provided that punchline to the Sabbatian Trump/QAnon Psyop.

On January 6th, 2021, a very big crowd of Trump supporters gathered in the National Mall in Washington DC down from the Capitol Building to protest at what they believed to be widespread corruption and vote fraud that stopped Trump being re-elected for a second term as president in November, 2020. I say as someone that does not support Trump or Biden that the evidence is clear that major vote-fixing went on to favour Biden, a man with cognitive problems so advanced he can often hardly string a sentence together without reading the words written for him on the Teleprompter. Glaring ballot discrepancies included serious questions about electronic voting machines that make vote rigging a comparative cinch and hundreds of thousands of paper votes that suddenly appeared during already advanced vote counts and virtually all of

them for Biden. Early Trump leads in crucial swing states suddenly began to close and disappear. The pandemic hoax was used as the excuse to issue almost limitless numbers of mail-in ballots with no checks to establish that the recipients were still alive or lived at that address. They were sent to streams of people who had not even asked for them. Private organisations were employed to gather these ballots and who knows what they did with them before they turned up at the counts. The American election system has been manipulated over decades to become a sick joke with more holes than a Swiss cheese for the express purpose of dictating the results. Then there was the criminal manipulation of information by Sabbatian tech giants like Facebook, Twitter and Google-owned YouTube which deleted pro-Trump, anti-Biden accounts and posts while everything in support of Biden was left alone. Sabbatians wanted Biden to win because after the dividing of America it was time for full-on Woke and every aspect of the Cult agenda to be unleashed.

Hunter gatherer

Extreme Silicon Valley bias included blocking information by the *New York Post* exposing a Biden scandal that should have ended his bid for president in the final weeks of the campaign. Hunter Biden, his monumentally corrupt son, is reported to have sent a laptop to be repaired at a local store and failed to return for it. Time passed until the laptop became the property of the store for non-payment of the bill. When the owner saw what was on the hard drive he gave a copy to the FBI who did nothing even though it confirmed widespread corruption in which the Joe Biden family were using his political position, especially when he was vice president to Obama, to make multiple millions in countries around the world and most notably Ukraine and China. Hunter Biden's one-time business partner Tony Bobulinski went public when the story broke in the *New York Post* to confirm the corruption he saw and that Joe Biden not only knew what was going on he also profited from the spoils. Millions were handed over by a Chinese company with close

connections – like all major businesses in China – to the Chinese communist party of President Xi Jinping. Joe Biden even boasted at a meeting of the Cult's World Economic Forum that as vice president he had ordered the government of Ukraine to fire a prosecutor. What he didn't mention was that the same man just happened to be investigating an energy company which was part of Hunter Biden's corrupt portfolio. The company was paying him big bucks for no other reason than the influence his father had. Overnight Biden's presidential campaign should have been over given that he had lied publicly about not knowing what his son was doing. Instead almost the entire Sabbatian-owned mainstream media and Sabbatian-owned Silicon Valley suppressed circulation of the story. This alone went a mighty way to rigging the election of 2020. Cult assets like Mark Zuckerberg at Facebook also spent hundreds of millions to be used in support of Biden and vote 'administration'.

The Cult had used Trump as the focus to divide America and was now desperate to bring in moronic, pliable, corrupt Biden to complete the double-whammy. No way were they going to let little things like the will of the people thwart their plan. Silicon Valley widely censored claims that the election was rigged because it *was* rigged. For the same reason anyone claiming it was rigged was denounced as a 'white supremacist' including the pathetically few Republican politicians willing to say so. Right across the media where the claim was mentioned it was described as a 'false claim' even though these excuses for 'journalists' would have done no research into the subject whatsoever. Trump won seven million more votes than any sitting president had ever achieved while somehow a cognitively-challenged soon to be 78-year-old who was hidden away from the public for most of the campaign managed to win more votes than any presidential candidate in history. It makes no sense. You only had to see election rallies for both candidates to witness the enthusiasm for Trump and the apathy for Biden. Tens of thousands would attend Trump events while Biden was speaking in empty car parks with often only television crews attending and framing their shots to hide the fact that no one was there. It was pathetic to see

footage come to light of Biden standing at a podium making speeches only to TV crews and party fixers while reading the words written for him on massive Teleprompter screens. So, yes, those protestors on January 6th had a point about election rigging, but some were about to walk into a trap laid for them in Washington by the Cult Deep State and its QAnon Psyop. This was the Capitol Hill riot ludicrously dubbed an 'insurrection'.

The spider and the fly

Renegade Minds know there are not two 'sides' in politics, only one side, the Cult, working through all 'sides'. It's a stage show, a puppet show, to direct the perceptions of the population into focusing on diversions like parties and candidates while missing the puppeteers with their hands holding all the strings. The Capitol Hill 'insurrection' brings us back to the Little Big Horn. Having created two distinct opposing groupings – Woke and Pushbackers – the trap was about to be sprung. Pushbackers were to be encircled and isolated by associating them all in the public mind with Trump and then labelling Trump as some sort of Confederate leader. I knew immediately that the Capitol riot was a set-up because of two things. One was how easy the rioters got into the building with virtually no credible resistance and secondly I could see – as with the 'Covid' hoax in the West at the start of 2020 – how the Cult could exploit the situation to move its agenda forward with great speed. My experience of Cult techniques and activities over more than 30 years has showed me that while they do exploit situations they haven't themselves created this never happens with events of fundamental agenda significance. Every time major events giving cultists the excuse to rapidly advance their plan you find they are manipulated into being for the specific reason of providing that excuse – Problem-Reaction-Solution. Only a tiny minority of the huge crowd of Washington protestors sought to gain entry to the Capitol by smashing windows and breaching doors. That didn't matter. The whole crowd and all Pushbackers, even if they did not support Trump, were going to be lumped together as dangerous

insurrectionists and conspiracy theorists. The latter term came into widespread use through a CIA memo in the 1960s aimed at discrediting those questioning the nonsensical official story of the Kennedy assassination and it subsequently became widely employed by the media. It's still being used by inept 'journalists' with no idea of its origin to discredit anyone questioning anything that authority claims to be true. When you are perpetrating a conspiracy you need to discredit the very word itself even though the dictionary definition of conspiracy is merely 'the activity of secretly planning with other people to do something bad or illegal' and 'a general agreement to keep silent about a subject for the purpose of keeping it secret'. On that basis there are conspiracies almost wherever you look. For obvious reasons the Cult and its lapdog media have to claim there are no conspiracies even though the word appears in state laws as with conspiracy to defraud, to murder, and to corrupt public morals.

Agent provocateurs are widely used by the Cult Deep State to manipulate genuine people into acting in ways that suit the desired outcome. By genuine in this case I mean protestors genuinely supporting Trump and claims that the election was stolen. In among them, however, were agents of the state wearing the garb of Trump supporters and QAnon to pump-prime the Capital riot which some genuine Trump supporters naively fell for. I described the situation as 'Come into my parlour said the spider to the fly'. Leaflets appeared through the Woke paramilitary arm Antifa, the anti-fascist fascists, calling on supporters to turn up in Washington looking like Trump supporters even though they hated him. Some of those arrested for breaching the Capitol Building were sourced to Antifa and its stable mate Black Lives Matter. Both organisations are funded by Cult billionaires and corporations. One man charged for the riot was according to his lawyer a former FBI agent who had held top secret security clearance for 40 years. Attorney Thomas Plofchan said of his client, 66-year-old Thomas Edward Caldwell:

He has held a Top Secret Security Clearance since 1979 and has undergone multiple Special Background Investigations in support of his clearances. After retiring from the Navy, he

worked as a section chief for the Federal Bureau of Investigation from 2009-2010 as a GS-12 [mid-level employee].

He also formed and operated a consulting firm performing work, often classified, for U.S government customers including the US. Drug Enforcement Agency, Department of Housing and Urban Development, the US Coast Guard, and the US Army Personnel Command.

A judge later released Caldwell pending trial in the absence of evidence about a conspiracy or that he tried to force his way into the building. *The New York Post* reported a 'law enforcement source' as saying that 'at least two known Antifa members were spotted' on camera among Trump supporters during the riot while one of the rioters arrested was John Earle Sullivan, a seriously extreme Black Lives Matter Trump-hater from Utah who was previously arrested and charged in July, 2020, over a BLM-Antifa riot in which drivers were threatened and one was shot. Sullivan is the founder of Utah-based Insurgence USA which is an affiliate of the Cult-created-and-funded Black Lives Matter movement. Footage appeared and was then deleted by Twitter of Trump supporters calling out Antifa infiltrators and a group was filmed changing into pro-Trump clothing before the riot. Security at the building was *pathetic* – as planned. Colonel Leroy Fletcher Prouty, a man with long experience in covert operations working with the US security apparatus, once described the tell-tale sign to identify who is involved in an assassination. He said:

No one has to direct an assassination – it happens. The active role is played secretly by permitting it to happen. This is the greatest single clue. Who has the power to call off or reduce the usual security precautions?

This principle applies to many other situations and certainly to the Capitol riot of January 6th, 2021.

The sting

With such a big and potentially angry crowd known to be gathering near the Capitol the security apparatus would have had a major police detail to defend the building with National Guard troops on

standby given the strength of feeling among people arriving from all over America encouraged by the QAnon Psyop and statements by Donald Trump. Instead Capitol Police 'security' was flimsy, weak, and easily breached. The same number of officers was deployed as on a regular day and that is a blatant red flag. They were not staffed or equipped for a possible riot that had been an obvious possibility in the circumstances. No protective and effective fencing worth the name was put in place and there were no contingency plans. The whole thing was basically a case of standing aside and waving people in. Once inside police mostly backed off apart from one Capitol police officer who ridiculously shot dead unarmed Air Force veteran protestor Ashli Babbitt without a warning as she climbed through a broken window. The 'investigation' refused to name or charge the officer after what must surely be considered a murder in the circumstances. They just lifted a carpet and swept. The story was endlessly repeated about five people dying in the 'armed insurrection' when there was no report of rioters using weapons. Apart from Babbitt the other four died from a heart attack, strokes and apparently a drug overdose. Capitol police officer Brian Sicknick was reported to have died after being bludgeoned with a fire extinguisher when he was alive after the riot was over and died later of what the Washington Medical Examiner's Office said was a stroke. Sicknick had no external injuries. The lies were delivered like rapid fire. There was a narrative to build with incessant repetition of the lie until the lie became the accepted 'everybody knows that' truth. The 'Big Lie' technique of Nazi Propaganda Minister Joseph Goebbels is constantly used by the Cult which was behind the Nazis and is today behind the 'Covid' and 'climate change' hoaxes. Goebbels said:

If you tell a lie big enough and keep repeating it, people will eventually come to believe it. The lie can be maintained only for such time as the State can shield the people from the political, economic and/or military consequences of the lie. It thus becomes vitally important for the State to use all of its powers to repress dissent, for the truth is the mortal enemy of the lie, and thus by extension, the truth is the greatest enemy of the State.

Most protestors had a free run of the Capitol Building. This allowed pictures to be taken of rioters in iconic parts of the building including the Senate chamber which could be used as propaganda images against all Pushbackers. One Congresswoman described the scene as 'the worst kind of non-security anybody could ever imagine'. Well, the first part was true, but someone obviously did imagine it and made sure it happened. Some photographs most widely circulated featured people wearing QAnon symbols and now the Psyop would be used to dub all QAnon followers with the ubiquitous fit-all label of 'white supremacist' and 'insurrectionists'. When a Muslim extremist called Noah Green drove his car at two police officers at the Capitol Building killing one in April, 2021, there was no such political and media hysteria. They were just disappointed he wasn't white.

The witch-hunt

Government prosecutor Michael Sherwin, an aggressive, dark-eyed, professional Rottweiler led the 'investigation' and to call it over the top would be to understate reality a thousand fold. Hundreds were tracked down and arrested for the crime of having the wrong political views and people were jailed who had done nothing more than walk in the building, committed no violence or damage to property, took a few pictures and left. They were labelled a 'threat to the Republic' while Biden sat in the White House signing executive orders written for him that were dismantling 'the Republic'. Even when judges ruled that a mother and son should not be in jail the government kept them there. Some of those arrested have been badly beaten by prison guards in Washington and lawyers for one man said he suffered a fractured skull and was made blind in one eye. Meanwhile a woman is shot dead for no reason by a Capitol Police officer and we are not allowed to know who he is never mind what has happened to him although that will be *nothing*. The Cult's QAnon/Trump sting to identify and isolate Pushbackers and then target them on the road to crushing and deleting them was a resounding success. You would have thought the Russians had

invaded the building at gunpoint and lined up senators for a firing squad to see the political and media reaction. Congresswoman Alexandria Ocasio-Cortez is a child in a woman's body, a terrible-twos, me, me, me, Woker narcissist of such proportions that words have no meaning. She said she thought she was going to die when 'insurrectionists' banged on her office door. It turned out she wasn't even in the Capitol Building when the riot was happening and the 'banging' was a Capitol Police officer. She referred to herself as a 'survivor' which is an insult to all those true survivors of violent and sexual abuse while she lives her pampered and privileged life talking drivel for a living. Her Woke colleague and fellow mega-narcissist Rashida Tlaib broke down describing the devastating effect on her, too, of *not being* in the building when the rioters were there. Ocasio-Cortez and Tlaib are members of a fully-Woke group of Congresswomen known as 'The Squad' along with Ilhan Omar and Ayanna Pressley. The Squad from what I can see can be identified by its vehement anti-white racism, anti-white men agenda, and, as always in these cases, the absence of brain cells on active duty.

The usual suspects were on the riot case immediately in the form of Democrat ultra-Zionist senators and operatives Chuck Schumer and Adam Schiff demanding that Trump be impeached for 'his part in the insurrection'. The same pair of prats had led the failed impeachment of Trump over the invented 'Russia collusion' nonsense which claimed Russia had helped Trump win the 2016 election. I didn't realise that Tel Aviv had been relocated just outside Moscow. I must find an up-to-date map. The Russia hoax was a Sabbatian operation to keep Trump occupied and impotent and to stop any rapport with Russia which the Cult wants to retain as a perceptual enemy to be pulled out at will. Puppet Biden began attacking Russia when he came to office as the Cult seeks more upheaval, division and war across the world. A two-year stage show 'Russia collusion inquiry' headed by the not-very-bright former 9/11 FBI chief Robert Mueller, with support from 19 lawyers, 40 FBI agents plus intelligence analysts, forensic accountants and other

staff, devoured tens of millions of dollars and found no evidence of Russia collusion which a ten-year-old could have told them on day one. Now the same moronic Schumer and Schiff wanted a second impeachment of Trump over the Capitol 'insurrection' (riot) which the arrested development of Schumer called another 'Pearl Harbor' while others compared it with 9/11 in which 3,000 died and, in the case of CNN, with the Rwandan genocide in the 1990s in which an estimated 500,000 to 600,000 were murdered, between 250, 000 and 500,000 women were raped, and populations of whole towns were hacked to death with machetes. To make those comparisons purely for Cult political reasons is beyond insulting to those that suffered and lost their lives and confirms yet again the callous inhumanity that we are dealing with. Schumer is a monumental idiot and so is Schiff, but they serve the Cult agenda and do whatever they're told so they get looked after. Talking of idiots – another inane man who spanned the Russia and Capitol impeachment attempts was Senator Eric Swalwell who had the nerve to accuse Trump of collusion with the Russians while sleeping with a Chinese spy called Christine Fang or 'Fang Fang' which is straight out of a Bond film no doubt starring Klaus Schwab as the bloke living on a secret island and controlling laser weapons positioned in space and pointing at world capitals. Fang Fang plays the part of Bond's infiltrator girlfriend which I'm sure she would enjoy rather more than sharing a bed with the brainless Swalwell, lying back and thinking of China. The FBI eventually warned Swalwell about Fang Fang which gave her time to escape back to the Chinese dictatorship. How very thoughtful of them. The second Trump impeachment also failed and hardly surprising when an impeachment is supposed to remove a sitting president and by the time it happened Trump was no longer president. These people are running your country America, well, officially anyway. Terrifying isn't it?

Outcomes tell the story - always

The outcome of all this – and it's the *outcome* on which Renegade Minds focus, not the words – was that a vicious, hysterical and

obviously pre-planned assault was launched on Pushbackers to censor, silence and discredit them and even targeted their right to earn a living. They have since been condemned as 'domestic terrorists' that need to be treated like Al-Qaeda and Islamic State. 'Domestic terrorists' is a label the Cult has been trying to make stick since the period of the Oklahoma bombing in 1995 which was blamed on 'far-right domestic terrorists'. If you read *The Trigger* you will see that the bombing was clearly a Problem-Reaction-Solution carried out by the Deep State during a Bill Clinton administration so corrupt that no dictionary definition of the term would even nearly suffice. Nearly 30, 000 troops were deployed from all over America to the empty streets of Washington for Biden's inauguration. Ten thousand of them stayed on with the pretext of protecting the capital from insurrectionists when it was more psychological programming to normalise the use of the military in domestic law enforcement in support of the Cult plan for a police-military state. Biden's fascist administration began a purge of 'wrong-thinkers' in the military which means anyone that is not on board with Woke. The Capitol Building was surrounded by a fence with razor wire and the Land of the Free was further symbolically and literally dismantled. The circle was completed with the installation of Biden and the exploitation of the QAnon Psyop.

America had never been so divided since the civil war of the 19th century, Pushbackers were isolated and dubbed terrorists and now, as was always going to happen, the Cult immediately set about deleting what little was left of freedom and transforming American society through a swish of the hand of the most controlled 'president' in American history leading (officially at least) the most extreme regime since the country was declared an independent state on July 4th, 1776. Biden issued undebated, dictatorial executive orders almost by the hour in his opening days in office across the whole spectrum of the Cult wish-list including diluting controls on the border with Mexico allowing thousands of migrants to illegally enter the United States to transform the demographics of America and import an election-changing number of perceived Democrat

voters. Then there were Biden deportation amnesties for the already illegally resident (estimated to be as high as 20 or even 30 million). A bill before Congress awarded American citizenship to anyone who could prove they had worked in agriculture for just 180 days in the previous two years as 'Big Ag' secured its slave labour long-term. There were the plans to add new states to the union such as Puerto Rico and making Washington DC a state. They are all parts of a plan to ensure that the Cult-owned Woke Democrats would be permanently in power.

Border – what border?

I have exposed in detail in other books how mass immigration into the United States and Europe is the work of Cult networks fuelled by the tens of billions spent to this and other ends by George Soros and his global Open Society (open borders) Foundations. The impact can be seen in America alone where the population has increased by *100 million* in little more than 30 years mostly through immigration. I wrote in *The Answer* that the plan was to have so many people crossing the southern border that the numbers become unstoppable and we are now there under Cult-owned Biden. El Salvador in Central America puts the scale of what is happening into context. A third of the population now lives in the United States, much of it illegally, and many more are on the way. The methodology is to crush Central and South American countries economically and spread violence through machete-wielding psychopathic gangs like MS-13 based in El Salvador and now operating in many American cities. Biden-imposed lax security at the southern border means that it is all but open. He said before his 'election' that he wanted to see a surge towards the border if he became president and that was the green light for people to do just that after election day to create the human disaster that followed for both America and the migrants. When that surge came the imbecilic Alexandria Ocasio-Cortez said it wasn't a 'surge' because they are 'children, not insurgents' and the term 'surge' (used by Biden) was a claim of 'white supremacists'.

This disingenuous lady may one day enter the realm of the most basic intelligence, but it won't be any time soon.

Sabbatians and the Cult are in the process of destroying America by importing violent people and gangs in among the genuine to terrorise American cities and by overwhelming services that cannot cope with the sheer volume of new arrivals. Something similar is happening in Europe as Western society in general is targeted for demographic and cultural transformation and upheaval. The plan demands violence and crime to create an environment of intimidation, fear and division and Soros has been funding the election of district attorneys across America who then stop prosecuting many crimes, reduce sentences for violent crimes and free as many violent criminals as they can. Sabbatians are creating the chaos from which order – their order – can respond in a classic Problem-Reaction-Solution. A Freemasonic moto says 'Ordo Ab Chao' (Order out of Chaos) and this is why the Cult is constantly creating chaos to impose a new 'order'. Here you have the reason the Cult is constantly creating chaos. The 'Covid' hoax can be seen with those entering the United States by plane being forced to take a 'Covid' test while migrants flooding through southern border processing facilities do not. Nothing is put in the way of mass migration and if that means ignoring the government's own 'Covid' rules then so be it. They know it's all bullshit anyway. Any pushback on this is denounced as 'racist' by Wokers and Sabbatian fronts like the ultra-Zionist Anti-Defamation League headed by the appalling Jonathan Greenblatt which at the same time argues that Israel should not give citizenship and voting rights to more Palestinian Arabs or the 'Jewish population' (in truth the Sabbatian network) will lose control of the country.

Society-changing numbers

Biden's masters have declared that countries like El Salvador are so dangerous that their people must be allowed into the United States for humanitarian reasons when there are fewer murders in large parts of many Central American countries than in US cities like

Baltimore. That is not to say Central America cannot be a dangerous place and Cult-controlled American governments have been making it so since way back, along with the dismantling of economies, in a long-term plan to drive people north into the United States. Parts of Central America are very dangerous, but in other areas the story is being greatly exaggerated to justify relaxing immigration criteria. Migrants are being offered free healthcare and education in the United States as another incentive to head for the border and there is no requirement to be financially independent before you can enter to prevent the resources of America being drained. You can't blame migrants for seeking what they believe will be a better life, but they are being played by the Cult for dark and nefarious ends. The numbers since Biden took office are huge. In February, 2021, more than 100,000 people were known to have tried to enter the US illegally through the southern border (it was 34,000 in the same month in 2020) and in March it was 170,000 – a 418 percent increase on March, 2020. These numbers are only known people, not the ones who get in unseen. The true figure for migrants illegally crossing the border in a single month was estimated by one congressman at 250,000 and that number will only rise under Biden's current policy. Gangs of murdering drug-running thugs that control the Mexican side of the border demand money – thousands of dollars – to let migrants cross the Rio Grande into America. At the same time gun battles are breaking out on the border several times a week between rival Mexican drug gangs (which now operate globally) who are equipped with sophisticated military-grade weapons, grenades and armoured vehicles. While the Capitol Building was being 'protected' from a non-existent 'threat' by thousands of troops, and others were still deployed at the time in the Cult Neocon war in Afghanistan, the southern border of America was left to its fate. This is not incompetence, it is cold calculation.

By March, 2021, there were 17,000 unaccompanied children held at border facilities and many of them are ensnared by people traffickers for paedophile rings and raped on their journey north to America. This is not conjecture – this is fact. Many of those designated

children are in reality teenage boys or older. Meanwhile Wokers posture their self-purity for encouraging poor and tragic people to come to America and face this nightmare both on the journey and at the border with the disgusting figure of House Speaker Nancy Pelosi giving disingenuous speeches about caring for migrants. The woman's evil. Wokers condemned Trump for having children in cages at the border (so did Obama, *Shhhh*), but now they are sleeping on the floor without access to a shower with one border facility 729 percent over capacity. The Biden insanity even proposed flying migrants from the southern border to the northern border with Canada for 'processing'. The whole shambles is being overseen by ultra-Zionist Secretary of Homeland Security, the moronic liar Alejandro Mayorkas, who banned news cameras at border facilities to stop Americans seeing what was happening. Mayorkas said there was not a ban on news crews; it was just that they were not allowed to film. Alongside him at Homeland Security is another ultra-Zionist Cass Sunstein appointed by Biden to oversee new immigration laws. Sunstein despises conspiracy researchers to the point where he suggests they should be banned or *taxed* for having such views. The man is not bonkers or anything. He's perfectly well-adjusted, but adjusted to what is the question. Criticise what is happening and you are a 'white supremacist' when earlier non-white immigrants also oppose the numbers which effect their lives and opportunities. Black people in poor areas are particularly damaged by uncontrolled immigration and the increased competition for work opportunities with those who will work for less. They are also losing voting power as Hispanics become more dominant in former black areas. It's a downward spiral for them while the billionaires behind the policy drone on about how much they care about black people and 'racism'. None of this is about compassion for migrants or black people – that's just wind and air. Migrants are instead being mercilessly exploited to transform America while the countries they leave are losing their future and the same is true in Europe. Mass immigration may now be the work of Woke Democrats, but it can be traced back to the 1986 Immigration Reform and Control Act (it

wasn't) signed into law by Republican hero President Ronald Reagan which gave amnesty to millions living in the United States illegally and other incentives for people to head for the southern border. Here we have the one-party state at work again.

Save me syndrome

Almost every aspect of what I have been exposing as the Cult agenda was on display in even the first days of 'Biden' with silencing of Pushbackers at the forefront of everything. A Renegade Mind will view the Trump years and QAnon in a very different light to their supporters and advocates as the dots are connected. The QAnon/Trump Psyop has given the Cult all it was looking for. We may not know how much, or little, that Trump realised he was being used, but that's a side issue. This pincer movement produced the desired outcome of dividing America and having Pushbackers isolated. To turn this around we have to look at new routes to empowerment which do not include handing our power to other people and groups through what I will call the 'Save Me Syndrome' – 'I want someone else to do it so that I don't have to'. We have seen this at work throughout human history and the QAnon/Trump Psyop is only the latest incarnation alongside all the others. Religion is an obvious expression of this when people look to a 'god' or priest to save them or tell them how to be saved and then there are 'save me' politicians like Trump. Politics is a diversion and not a 'saviour'. It is a means to block positive change, not make it possible.

Save Me Syndrome always comes with the same repeating theme of handing your power to whom or what you believe will save you while your real 'saviour' stares back from the mirror every morning. Renegade Minds are constantly vigilant in this regard and always asking the question 'What can I do?' rather than 'What can someone else do for me?' Gandhi was right when he said: 'You must be the change you want to see in the world.' We are indeed the people we have been waiting for. We are presented with a constant raft of reasons to concede that power to others and forget where the real power is. Humanity has the numbers and the Cult does not. It has to

use diversion and division to target the unstoppable power that comes from unity. Religions, governments, politicians, corporations, media, QAnon, are all different manifestations of this power-diversion and dilution. Refusing to give your power to governments and instead handing it to Trump and QAnon is not to take a new direction, but merely to recycle the old one with new names on the posters. I will explore this phenomenon as we proceed and how to break the cycles and recycles that got us here through the mists of repeating perception and so repeating history.

For now we shall turn to the most potent example in the entire human story of the consequences that follow when you give your power away. I am talking, of course, of the 'Covid' hoax.

CHAPTER FOUR

'Covid': Calculated catastrophe

Facts are threatening to those invested in fraud
DaShanne Stokes

We can easily unravel the real reason for the 'Covid pandemic' hoax by employing the Renegade Mind methodology that I have outlined this far. We'll start by comparing the long-planned Cult outcome with the 'Covid pandemic' outcome. Know the outcome and you'll see the journey.

I have highlighted the plan for the Hunger Games Society which has been in my books for so many years with the very few controlling the very many through ongoing dependency. To create this dependency it is essential to destroy independent livelihoods, businesses and employment to make the population reliant on the state (the Cult) for even the basics of life through a guaranteed pittance income. While independence of income remained these Cult ambitions would be thwarted. With this knowledge it was easy to see where the 'pandemic' hoax was going once talk of 'lockdowns' began and the closing of all but perceived 'essential' businesses to 'save' us from an alleged 'deadly virus'. Cult corporations like Amazon and Walmart were naturally considered 'essential' while mom and pop shops and stores had their doors closed by fascist decree. As a result with every new lockdown and new regulation more small and medium, even large businesses not owned by the Cult, went to the wall while Cult giants and their frontmen and women grew financially fatter by the second. Mom and pop were

denied an income and the right to earn a living and the wealth of people like Jeff Bezos (Amazon), Mark Zuckerberg (Facebook) and Sergei Brin and Larry Page (Google/Alphabet) have reached record levels. The Cult was increasing its own power through further dramatic concentrations of wealth while the competition was being destroyed and brought into a state of dependency. Lockdowns have been instigated to secure that very end and were never anything to do with health. My brother Paul spent 45 years building up a bus repair business, but lockdowns meant buses were running at a fraction of normal levels for months on end. Similar stories can told in their hundreds of millions worldwide. Efforts of a lifetime coldly destroyed by Cult multi-billionaires and their lackeys in government and law enforcement who continued to earn their living from the taxation of the people while denying the right of the same people to earn theirs. How different it would have been if those making and enforcing these decisions had to face the same financial hardships of those they affected, but they never do.

Gates of Hell

Behind it all in the full knowledge of what he is doing and why is the psychopathic figure of Cult operative Bill Gates. His puppet Tedros at the World Health Organization declared 'Covid' a pandemic in March, 2020. The WHO had changed the definition of a 'pandemic' in 2009 just a month before declaring the 'swine flu pandemic' which would not have been so under the previous definition. The same applies to 'Covid'. The definition had included… 'an infection by an infectious agent, occurring simultaneously in different countries, with a significant mortality rate relative to the proportion of the population infected'. The new definition removed the need for 'significant mortality'. The 'pandemic' has been fraudulent even down to the definition, but Gates demanded economy-destroying lockdowns, school closures, social distancing, mandatory masks, a 'vaccination' for every man, woman and child on the planet and severe consequences and restrictions for those that refused. Who gave him this power? The

Cult did which he serves like a little boy in short trousers doing what his daddy tells him. He and his psychopathic missus even smiled when they said that much worse was to come (what they knew was planned to come). Gates responded in the matter-of-fact way of all psychopaths to a question about the effect on the world economy of what he was doing:

> Well, it won't go to zero but it will shrink. Global GDP is probably going to take the biggest hit ever [Gates was smiling as he said this] … in my lifetime this will be the greatest economic hit. But you don't have a choice. People act as if you have a choice. People don't feel like going to the stadium when they might get infected … People are deeply affected by seeing these stats, by knowing they could be part of the transmission chain, old people, their parents and grandparents, could be affected by this, and so you don't get to say ignore what is going on here.
>
> There will be the ability to open up, particularly in rich countries, if things are done well over the next few months, but for the world at large normalcy only returns when we have largely vaccinated the entire population.

The man has no compassion or empathy. How could he when he's a psychopath like all Cult players? My own view is that even beyond that he is very seriously mentally ill. Look in his eyes and you can see this along with his crazy flailing arms. You don't do what he has done to the world population since the start of 2020 unless you are mentally ill and at the most extreme end of psychopathic. You especially don't do it when to you know, as we shall see, that cases and deaths from 'Covid' are fakery and a product of monumental figure massaging. 'These stats' that Gates referred to are based on a 'test' that's not testing for the 'virus' as he has known all along. He made his fortune with big Cult support as an infamously ruthless software salesman and now buys global control of 'health' (death) policy without the population he affects having any say. It's a breathtaking outrage. Gates talked about people being deeply affected by fear of 'Covid' when that was because of *him* and his global network lying to them minute-by-minute supported by a lying media that he seriously influences and funds to the tune of hundreds of millions. He's handed big sums to media operations including the BBC, NBC, Al Jazeera, Univision, *PBS NewsHour*,

ProPublica, National Journal, The Guardian, The Financial Times, The Atlantic, Texas Tribune, USA Today publisher Gannett, *Washington Monthly, Le Monde,* Center for Investigative Reporting, Pulitzer Center on Crisis Reporting, National Press Foundation, International Center for Journalists, Solutions Journalism Network, the Poynter Institute for Media Studies, and many more. Gates is everywhere in the 'Covid' hoax and the man must go to prison – or a mental facility – for the rest of his life and his money distributed to those he has taken such enormous psychopathic pleasure in crushing.

The Muscle

The Hunger Games global structure demands a police-military state – a fusion of the two into one force – which viciously imposes the will of the Cult on the population and protects the Cult from public rebellion. In that regard, too, the 'Covid' hoax just keeps on giving. Often unlawful, ridiculous and contradictory 'Covid' rules and regulations have been policed across the world by moronic automatons and psychopaths made faceless by face-nappy masks and acting like the Nazi SS and fascist blackshirts and brownshirts of Hitler and Mussolini. The smallest departure from the rules decreed by the psychos in government and their clueless gofers were jumped upon by the face-nappy fascists. Brutality against public protestors soon became commonplace even on girls, women and old people as the brave men with the batons – the Face-Nappies as I call them – broke up peaceful protests and handed out fines like confetti to people who couldn't earn a living let alone pay hundreds of pounds for what was once an accepted human right. Robot Face-Nappies of Nottingham police in the English East Midlands fined one group £11,000 for attending a child's birthday party. For decades I charted the transformation of law enforcement as genuine, decent officers were replaced with psychopaths and the brain dead who would happily and brutally do whatever their masters told them. Now they were let loose on the public and I would emphasise the point that none of this just happened. The step-by-step change in the dynamic between police and public was orchestrated from the shadows by

those who knew where this was all going and the same with the perceptual reframing of those in all levels of authority and official administration through 'training courses' by organisations such as Common Purpose which was created in the late 1980s and given a massive boost in Blair era Britain until it became a global phenomenon. Supposed public 'servants' began to view the population as the enemy and the same was true of the police. This was the start of the explosion of behaviour manipulation organisations and networks preparing for the all-war on the human psyche unleashed with the dawn of 2020. I will go into more detail about this later in the book because it is a core part of what is happening.

Police desecrated beauty spots to deter people gathering and arrested women for walking in the countryside alone 'too far' from their homes. We had arrogant, clueless sergeants in the Isle of Wight police where I live posting on Facebook what they insisted the population must do or else. A schoolmaster sergeant called Radford looked young enough for me to ask if his mother knew he was out, but he was posting what he *expected* people to do while a Sergeant Wilkinson boasted about fining lads for meeting in a McDonald's car park where they went to get a lockdown takeaway. Wilkinson added that he had even cancelled their order. What a pair of prats these people are and yet they have increasingly become the norm among Jackboot Johnson's Yellowshirts once known as the British police. This was the theme all over the world with police savagery common during lockdown protests in the United States, the Netherlands, and the fascist state of Victoria in Australia under its tyrannical and again moronic premier Daniel Andrews. Amazing how tyrannical and moronic tend to work as a team and the same combination could be seen across America as arrogant, narcissistic Woke governors and mayors such as Gavin Newsom (California), Andrew Cuomo (New York), Gretchen Whitmer (Michigan), Lori Lightfoot (Chicago) and Eric Garcetti (Los Angeles) did their Nazi and Stalin impressions with the full support of the compliant brutality of their enforcers in uniform as they arrested small business owners defying

fascist shutdown orders and took them to jail in ankle shackles and handcuffs. This happened to bistro owner Marlena Pavlos-Hackney in Gretchen Whitmer's fascist state of Michigan when police arrived to enforce an order by a state-owned judge for 'putting the community at risk' at a time when other states like Texas were dropping restrictions and migrants were pouring across the southern border without any 'Covid' questions at all. I'm sure there are many officers appalled by what they are ordered to do, but not nearly enough of them. If they were truly appalled they would not do it. As the months passed every opportunity was taken to have the military involved to make their presence on the streets ever more familiar and 'normal' for the longer-term goal of police-military fusion.

Another crucial element to the Hunger Games enforcement network has been encouraging the public to report neighbours and others for 'breaking the lockdown rules'. The group faced with £11,000 in fines at the child's birthday party would have been dobbed-in by a neighbour with a brain the size of a pea. The technique was most famously employed by the Stasi secret police in communist East Germany who had public informants placed throughout the population. A police chief in the UK says his force doesn't need to carry out 'Covid' patrols when they are flooded with so many calls from the public reporting other people for visiting the beach. Dorset police chief James Vaughan said people were so enthusiastic about snitching on their fellow humans they were now operating as an auxiliary arm of the police: 'We are still getting around 400 reports a week from the public, so we will respond to reports …We won't need to be doing hotspot patrols because people are very quick to pick the phone up and tell us.' Vaughan didn't say that this is a pillar of all tyrannies of whatever complexion and the means to hugely extend the reach of enforcement while spreading distrust among the people and making them wary of doing anything that might get them reported. Those narcissistic Isle of Wight sergeants Radford and Wilkinson never fail to add a link to their Facebook posts where the public can inform on their fellow slaves.

Neither would be self-aware enough to realise they were imitating the Stasi which they might well never have heard of. Government psychologists that I will expose later laid out a policy to turn communities against each other in the same way.

A coincidence? Yep, and I can knit fog

I knew from the start of the alleged pandemic that this was a Cult operation. It presented limitless potential to rapidly advance the Cult agenda and exploit manipulated fear to demand that every man, woman and child on the planet was 'vaccinated' in a process never used on humans before which infuses self-replicating *synthetic* material into human cells. Remember the plan to transform the human body from a biological to a synthetic biological state. I'll deal with the 'vaccine' (that's not actually a vaccine) when I focus on the genetic agenda. Enough to say here that mass global 'vaccination' justified by this 'new virus' set alarms ringing after 30 years of tracking these people and their methods. The 'Covid' hoax officially beginning in China was also a big red flag for reasons I will be explaining. The agenda potential was so enormous that I could dismiss any idea that the 'virus' appeared naturally. Major happenings with major agenda implications never occur without Cult involvement in making them happen. My questions were twofold in early 2020 as the media began its campaign to induce global fear and hysteria: Was this alleged infectious agent released on purpose by the Cult or did it even exist at all? I then did what I always do in these situations. I sat, observed and waited to see where the evidence and information would take me. By March and early April synchronicity was strongly – and ever more so since then – pointing me in the direction of *there is no 'virus'*. I went public on that with derision even from swathes of the alternative media that voiced a scenario that the Chinese government released the 'virus' in league with Deep State elements in the United States from a top-level bio-lab in Wuhan where the 'virus' is said to have first appeared. I looked at that possibility, but I didn't buy it for several reasons. Deaths from the 'virus' did not in any way match what they

would have been with a 'deadly bioweapon' and it is much more effective if you sell the *illusion* of an infectious agent rather than having a real one unless you can control through injection who has it and who doesn't. Otherwise you lose control of events. A made-up 'virus' gives you a blank sheet of paper on which you can make it do whatever you like and have any symptoms or mutant 'variants' you choose to add while a real infectious agent would limit you to what it actually does. A phantom disease allows you to have endless ludicrous 'studies' on the 'Covid' dollar to widen the perceived impact by inventing ever more 'at risk' groups including one study which said those who walk slowly may be almost four times more likely to die from the 'virus'. People are in psychiatric wards for less.

A real 'deadly bioweapon' can take out people in the hierarchy that are not part of the Cult, but essential to its operation. Obviously they don't want that. Releasing a real disease means you immediately lose control of it. Releasing an illusory one means you don't. Again it's vital that people are extra careful when dealing with what they want to hear. A bioweapon unleashed from a Chinese laboratory in collusion with the American Deep State may fit a conspiracy narrative, but is it true? Would it not be far more effective to use the excuse of a 'virus' to justify the real bioweapon – the 'vaccine'? That way your disease agent does not have to be transmitted and arrives directly through a syringe. I saw a French virologist Luc Montagnier quoted in the alternative media as saying he had discovered that the alleged 'new' severe acute respiratory syndrome coronavirus , or SARS-CoV-2, was made artificially and included elements of the human immunodeficiency 'virus' (HIV) and a parasite that causes malaria. SARS-CoV-2 is alleged to trigger an alleged illness called Covid-19. I remembered Montagnier's name from my research years before into claims that an HIV 'retrovirus' causes AIDs – claims that were demolished by Berkeley virologist Peter Duesberg who showed that no one had ever proved that HIV causes acquired immunodeficiency syndrome or AIDS. Claims that become accepted as fact, publicly and medically, with no proof whatsoever are an ever-recurring story that profoundly applies to

'Covid'. Nevertheless, despite the lack of proof, Montagnier's team at the Pasteur Institute in Paris had a long dispute with American researcher Robert Gallo over which of them discovered and isolated the HIV 'virus' and with *no evidence* found it to cause AIDS. You will see later that there is also no evidence that any 'virus' causes any disease or that there is even such a thing as a 'virus' in the way it is said to exist. The claim to have 'isolated' the HIV 'virus' will be presented in its real context as we come to the shocking story – and it is a story – of SARS-CoV-2 and so will Montagnier's assertion that he identified the full SARS-CoV-2 genome.

Hoax in the making

We can pick up the 'Covid' story in 2010 and the publication by the Rockefeller Foundation of a document called 'Scenarios for the Future of Technology and International Development'. The inner circle of the Rockefeller family has been serving the Cult since John D. Rockefeller (1839-1937) made his fortune with Standard Oil. It is less well known that the same Rockefeller – the Bill Gates of his day – was responsible for establishing what is now referred to as 'Big Pharma', the global network of pharmaceutical companies that make outrageous profits dispensing scalpel and drug 'medicine' and are obsessed with pumping vaccines in ever-increasing number into as many human arms and backsides as possible. John D. Rockefeller was the driving force behind the creation of the 'education' system in the United States and elsewhere specifically designed to program the perceptions of generations thereafter. The Rockefeller family donated exceptionally valuable land in New York for the United Nations building and were central in establishing the World Health Organization in 1948 as an agency of the UN which was created from the start as a Trojan horse and stalking horse for world government. Now enter Bill Gates. His family and the Rockefellers have long been extremely close and I have seen genealogy which claims that if you go back far enough the two families fuse into the same bloodline. Gates has said that the Bill and Melinda Gates Foundation was inspired by the Rockefeller Foundation and why not

when both are serving the same Cult? Major tax-exempt foundations are overwhelmingly criminal enterprises in which Cult assets fund the Cult agenda in the guise of 'philanthropy' while avoiding tax in the process. Cult operatives can become mega-rich in their role of front men and women for the psychopaths at the inner core and they, too, have to be psychopaths to knowingly serve such evil. Part of the deal is that a big percentage of the wealth gleaned from representing the Cult has to be spent advancing the ambitions of the Cult and hence you have the Rockefeller Foundation, Bill and Melinda Gates Foundation (and *so* many more) and people like George Soros with his global Open Society Foundations spending their billions in pursuit of global Cult control. Gates is a global public face of the Cult with his interventions in world affairs including Big Tech influence; a central role in the 'Covid' and 'vaccine' scam; promotion of the climate change shakedown; manipulation of education; geoengineering of the skies; and his food-control agenda as the biggest owner of farmland in America, his GMO promotion and through other means. As one writer said: 'Gates monopolizes or wields disproportionate influence over the tech industry, global health and vaccines, agriculture and food policy (including biopiracy and fake food), weather modification and other climate technologies, surveillance, education and media.' The almost limitless wealth secured through Microsoft and other not-allowed-to-fail ventures (including vaccines) has been ploughed into a long, long list of Cult projects designed to enslave the entire human race. Gates and the Rockefellers have been working as one unit with the Rockefeller-established World Health Organization leading global 'Covid' policy controlled by Gates through his mouth-piece Tedros. Gates became the WHO's biggest funder when Trump announced that the American government would cease its donations, but Biden immediately said he would restore the money when he took office in January, 2021. The Gates Foundation (the Cult) owns through limitless funding the world health system and the major players across the globe in the 'Covid' hoax.

Okay, with that background we return to that Rockefeller Foundation document of 2010 headed 'Scenarios for the Future of Technology and International Development' and its 'imaginary' epidemic of a virulent and deadly influenza strain which infected 20 percent of the global population and killed eight million in seven months. The Rockefeller scenario was that the epidemic destroyed economies, closed shops, offices and other businesses and led to governments imposing fierce rules and restrictions that included mandatory wearing of face masks and body-temperature checks to enter communal spaces like railway stations and supermarkets. The document predicted that even after the height of the Rockefeller-envisaged epidemic the authoritarian rule would continue to deal with further pandemics, transnational terrorism, environmental crises and rising poverty. Now you may think that the Rockefellers are our modern-day seers or alternatively, and rather more likely, that they well knew what was planned a few years further on. Fascism had to be imposed, you see, to 'protect citizens from risk and exposure'. The Rockefeller scenario document said:

During the pandemic, national leaders around the world flexed their authority and imposed airtight rules and restrictions, from the mandatory wearing of face masks to body-temperature checks at the entries to communal spaces like train stations and supermarkets. Even after the pandemic faded, this more authoritarian control and oversight of citizens and their activities stuck and even intensified. In order to protect themselves from the spread of increasingly global problems – from pandemics and transnational terrorism to environmental crises and rising poverty – leaders around the world took a firmer grip on power.

At first, the notion of a more controlled world gained wide acceptance and approval. Citizens willingly gave up some of their sovereignty – and their privacy – to more paternalistic states in exchange for greater safety and stability. Citizens were more tolerant, and even eager, for top-down direction and oversight, and national leaders had more latitude to impose order in the ways they saw fit.

In developed countries, this heightened oversight took many forms: biometric IDs for all citizens, for example, and tighter regulation of key industries whose stability was deemed vital to national interests. In many developed countries, enforced cooperation with a suite of new regulations and agreements slowly but steadily restored both order and, importantly, economic growth.

There we have the prophetic Rockefellers in 2010 and three years later came their paper for the Global Health Summit in Beijing, China, when government representatives, the private sector, international organisations and groups met to discuss the next 100 years of 'global health'. The Rockefeller Foundation-funded paper was called 'Dreaming the Future of Health for the Next 100 Years and more prophecy ensued as it described a dystopian future: 'The abundance of data, digitally tracking and linking people may mean the 'death of privacy' and may replace physical interaction with transient, virtual connection, generating isolation and raising questions of how values are shaped in virtual networks.' Next in the 'Covid' hoax preparation sequence came a 'table top' simulation in 2018 for another 'imaginary' pandemic of a disease called Clade X which was said to kill 900 million people. The exercise was organised by the Gates-funded Johns Hopkins University's Center for Health Security in the United States and this is the very same university that has been compiling the disgustingly and systematically erroneous global figures for 'Covid' cases and deaths. Similar Johns Hopkins health crisis scenarios have included the Dark Winter exercise in 2001 and Atlantic Storm in 2005.

Nostradamus 201

For sheer predictive genius look no further prophecy-watchers than the Bill Gates-funded Event 201 held only six weeks before the 'coronavirus pandemic' is supposed to have broken out in China and Event 201 was based on a scenario of a global 'coronavirus pandemic'. Melinda Gates, the great man's missus, told the BBC that he had 'prepared for years' for a coronavirus pandemic which told us what we already knew. Nostradamugates had predicted in a TED talk in 2015 that a pandemic was coming that would kill a lot of people and demolish the world economy. My god, the man is a machine – possibly even literally. Now here he was only weeks before the real thing funding just such a simulated scenario and involving his friends and associates at Johns Hopkins, the World Economic Forum Cult-front of Klaus Schwab, the United Nations,

Johnson & Johnson, major banks, and officials from China and the Centers for Disease Control in the United States. What synchronicity – Johns Hopkins would go on to compile the fraudulent 'Covid' figures, the World Economic Forum and Schwab would push the 'Great Reset' in response to 'Covid', the Centers for Disease Control would be at the forefront of 'Covid' policy in the United States, Johnson & Johnson would produce a 'Covid vaccine', and everything would officially start just weeks later in China. Spooky, eh? They were even accurate in creating a simulation of a 'virus' pandemic because the 'real thing' would also be a simulation. Event 201 was not an exercise preparing for something that might happen; it was a rehearsal for what those in control knew was *going* to happen and very shortly. Hours of this simulation were posted on the Internet and the various themes and responses mirrored what would soon be imposed to transform human society. News stories were inserted and what they said would be commonplace a few weeks later with still more prophecy perfection. Much discussion focused on the need to deal with misinformation and the 'anti-vax movement' which is exactly what happened when the 'virus' arrived – was said to have arrived – in the West.

Cult-owned social media banned criticism and exposure of the official 'virus' narrative and when I said there *was* no 'virus' in early April, 2020, I was banned by one platform after another including YouTube, Facebook and later Twitter. The mainstream broadcast media in Britain was in effect banned from interviewing me by the Tony-Blair-created government broadcasting censor Ofcom headed by career government bureaucrat Melanie Dawes who was appointed just as the 'virus' hoax was about to play out in January, 2020. At the same time the Ickonic media platform was using Vimeo, another ultra-Zionist-owned operation, while our own player was being created and they deleted in an instant hundreds of videos, documentaries, series and shows to confirm their unbelievable vindictiveness. We had copies, of course, and they had to be restored one by one when our player was ready. These people have no class. Sabbatian Facebook promised free advertisements for the Gates-

controlled World Health Organization narrative while deleting 'false claims and conspiracy theories' to stop 'misinformation' about the alleged coronavirus. All these responses could be seen just a short while earlier in the scenarios of Event 201. Extreme censorship was absolutely crucial for the Cult because the official story was so ridiculous and unsupportable by the evidence that it could never survive open debate and the free-flow of information and opinion. If you can't win a debate then don't have one is the Cult's approach throughout history. Facebook's little boy front man – front boy – Mark Zuckerberg equated 'credible and accurate information' with official sources and exposing their lies with 'misinformation'.

Silencing those that can see

The censorship dynamic of Event 201 is now the norm with an army of narrative-supporting 'fact-checker' organisations whose entire reason for being is to tell the public that official narratives are true and those exposing them are lying. One of the most appalling of these 'fact-checkers' is called NewsGuard founded by ultra-Zionist Americans Gordon Crovitz and Steven Brill. Crovitz is a former publisher of *The Wall Street Journal*, former Executive Vice President of Dow Jones, a member of the Council on Foreign Relations (CFR), and on the board of the American Association of Rhodes Scholars. The CFR and Rhodes Scholarships, named after Rothschild agent Cecil Rhodes who plundered the gold and diamonds of South Africa for his masters and the Cult, have featured widely in my books. NewsGuard don't seem to like me for some reason – I really can't think why – and they have done all they can to have me censored and discredited which is, to quote an old British politician, like being savaged by a dead sheep. They are, however, like all in the censorship network, very well connected and funded by organisations themselves funded by, or connected to, Bill Gates. As you would expect with anything associated with Gates NewsGuard has an offshoot called HealthGuard which 'fights online health care hoaxes'. How very kind. Somehow the NewsGuard European Managing Director Anna-Sophie Harling, a remarkably young-

looking woman with no broadcasting experience and little hands-on work in journalism, has somehow secured a position on the 'Content Board' of UK government broadcast censor Ofcom. An executive of an organisation seeking to discredit dissidents of the official narratives is making decisions for the government broadcast 'regulator' about content?? Another appalling 'fact-checker' is Full Fact funded by George Soros and global censors Google and Facebook.

It's amazing how many activists in the 'fact-checking', 'anti-hate', arena turn up in government-related positions – people like UK Labour Party activist Imran Ahmed who heads the Center for Countering Digital Hate founded by people like Morgan McSweeney, now chief of staff to the Labour Party's hapless and useless 'leader' Keir Starmer. Digital Hate – which is what it really is – uses the American spelling of Center to betray its connection to a transatlantic network of similar organisations which in 2020 shapeshifted from attacking people for 'hate' to attacking them for questioning the 'Covid' hoax and the dangers of the 'Covid vaccine'. It's just a coincidence, you understand. This is one of Imran Ahmed's hysterical statements: 'I would go beyond calling anti-vaxxers conspiracy theorists to say they are an extremist group that pose a national security risk.' No one could ever accuse this prat of understatement and he's including in that those parents who are now against vaccines after their children were damaged for life or killed by them. He's such a nice man. Ahmed does the rounds of the Woke media getting soft-ball questions from spineless 'journalists' who never ask what right he has to campaign to destroy the freedom of speech of others while he demands it for himself. There also seems to be an overrepresentation in Ofcom of people connected to the narrative-worshipping BBC. This incredible global network of narrative-support was super-vital when the 'Covid' hoax was played in the light of the mega-whopper lies that have to be defended from the spotlight cast by the most basic intelligence.

Setting the scene

The Cult plays the long game and proceeds step-by-step ensuring that everything is in place before major cards are played and they don't come any bigger than the 'Covid' hoax. The psychopaths can't handle events where the outcome isn't certain and as little as possible – preferably nothing – is left to chance. Politicians, government and medical officials who would follow direction were brought to illusory power in advance by the Cult web whether on the national stage or others like state governors and mayors of America. For decades the dynamic between officialdom, law enforcement and the public was changed from one of service to one of control and dictatorship. Behaviour manipulation networks established within government were waiting to impose the coming 'Covid' rules and regulations specifically designed to subdue and rewire the psyche of the people in the guise of protecting health. These included in the UK the Behavioural Insights Team part-owned by the British government Cabinet Office; the Scientific Pandemic Insights Group on Behaviours (SPI-B); and a whole web of intelligence and military groups seeking to direct the conversation on social media and control the narrative. Among them are the cyberwarfare (on the people) 77th Brigade of the British military which is also coordinated through the Cabinet Office as civilian and military leadership continues to combine in what they call the Fusion Doctrine. The 77th Brigade is a British equivalent of the infamous Israeli (Sabbatian) military cyberwarfare and Internet manipulation operation Unit 8200 which I expose at length in *The Trigger*. Also carefully in place were the medical and science advisers to government – many on the payroll past or present of Bill Gates – and a whole alternative structure of unelected government stood by to take control when elected parliaments were effectively closed down once the 'Covid' card was slammed on the table. The structure I have described here and so much more was installed in every major country through the Cult networks. The top-down control hierarchy looks like this: The Cult – Cult-owned Gates – the World Health Organization and Tedros – Gates-funded or controlled chief medical officers and science 'advisers' (dictators) in each country –

political 'leaders'– law enforcement – The People. Through this simple global communication and enforcement structure the policy of the Cult could be imposed on virtually the entire human population so long as they acquiesced to the fascism. With everything in place it was time for the button to be pressed in late 2019/early 2020.

These were the prime goals the Cult had to secure for its will to prevail:

1) Locking down economies, closing all but designated 'essential' businesses (Cult-owned corporations were 'essential'), and putting the population under house arrest was an imperative to destroy independent income and employment and ensure dependency on the Cult-controlled state in the Hunger Games Society. Lockdowns had to be established as the global blueprint from the start to respond to the 'virus' and followed by pretty much the entire world.

2) The global population had to be terrified into believing in a deadly 'virus' that didn't actually exist so they would unquestioningly obey authority in the belief that authority must know how best to protect them and their families. Software salesman Gates would suddenly morph into the world's health expert and be promoted as such by the Cult-owned media.

3) A method of testing that wasn't testing for the 'virus', but was only claimed to be, had to be in place to provide the illusion of 'cases' and subsequent 'deaths' that had a very different cause to the 'Covid-19' that would be scribbled on the death certificate.

4) Because there was no 'virus' and the great majority testing positive with a test not testing for the 'virus' would have no symptoms of anything the lie had to be sold that people without symptoms (without the 'virus') could still pass it on to others. This was crucial to justify for the first time quarantining – house arresting – healthy people. Without this the economy-destroying lockdown of *everybody* could not have been credibly sold.

5) The 'saviour' had to be seen as a vaccine which beyond evil drug companies were working like angels of mercy to develop as quickly as possible, with all corners cut, to save the day. The public must absolutely not know that the 'vaccine' had nothing to do with a 'virus' or that the contents were ready and waiting with a very different motive long before the 'Covid' card was even lifted from the pack.

I said in March, 2020, that the 'vaccine' would have been created way ahead of the 'Covid' hoax which justified its use and the following December an article in the New York *Intelligencer* magazine said the Moderna 'vaccine' had been 'designed' by

January, 2020. This was 'before China had even acknowledged that the disease could be transmitted from human to human, more than a week before the first confirmed coronavirus case in the United States'. The article said that by the time the first American death was announced a month later 'the vaccine had already been manufactured and shipped to the National Institutes of Health for the beginning of its Phase I clinical trial'. The 'vaccine' was actually 'designed' long before that although even with this timescale you would expect the article to ask how on earth it could have been done that quickly. Instead it asked why the 'vaccine' had not been rolled out then and not months later. Journalism in the mainstream is truly dead. I am going to detail in the next chapter why the 'virus' has never existed and how a hoax on that scale was possible, but first the foundation on which the Big Lie of 'Covid' was built.

The test that doesn't test

Fraudulent 'testing' is the bottom line of the whole 'Covid' hoax and was the means by which a 'virus' that did not exist *appeared* to exist. They could only achieve this magic trick by using a test not testing for the 'virus'. To use a test that *was* testing for the 'virus' would mean that every test would come back negative given there was no 'virus'. They chose to exploit something called the RT-PCR test invented by American biochemist Kary Mullis in the 1980s who said publicly that his PCR test … *cannot detect infectious disease*. Yes, the 'test' used worldwide to detect infectious 'Covid' to produce all the illusory 'cases' and 'deaths' compiled by Johns Hopkins and others *cannot detect infectious disease*. This fact came from the mouth of the man who invented PCR and was awarded the Nobel Prize in Chemistry in 1993 for doing so. Sadly, and incredibly conveniently for the Cult, Mullis died in August, 2019, at the age of 74 just before his test would be fraudulently used to unleash fascism on the world. He was said to have died from pneumonia which was an irony in itself. A few months later he would have had 'Covid-19' on his death certificate. I say the timing of his death was convenient because had he lived Mullis, a brilliant, honest and decent man, would have been

vociferously speaking out against the use of his test to detect 'Covid' when it was never designed, or able, to do that. I know that to be true given that Mullis made the same point when his test was used to 'detect' – not detect – HIV. He had been seriously critical of the Gallo/Montagnier claim to have isolated the HIV 'virus' and shown it to cause AIDS for which Mullis said there was no evidence. AIDS is actually not a disease but a series of diseases from which people die all the time. When they die from those *same diseases* after a positive 'test' for HIV then AIDS goes on their death certificate. I think I've heard that before somewhere. Countries instigated a policy with 'Covid' that anyone who tested positive with a test not testing for the 'virus' and died of any other cause within 28 days and even longer 'Covid-19' had to go on the death certificate. Cases have come from the test that can't test for infectious disease and the deaths are those who have died of *anything* after testing positive with a test not testing for the 'virus'. I'll have much more later about the death certificate scandal.

Mullis was deeply dismissive of the now US 'Covid' star Anthony Fauci who he said was a liar who didn't know anything about anything – 'and I would say that to his face – nothing.' He said of Fauci: 'The man thinks he can take a blood sample, put it in an electron microscope and if it's got a virus in there you'll know it – he doesn't understand electron microscopy and he doesn't understand medicine and shouldn't be in a position like he's in.' That position, terrifyingly, has made him the decider of 'Covid' fascism policy on behalf of the Cult in his role as director since 1984 of the National Institute of Allergy and Infectious Diseases (NIAID) while his record of being wrong is laughable; but being wrong, so long as it's the *right kind* of wrong, is why the Cult loves him. He'll say anything the Cult tells him to say. Fauci was made Chief Medical Adviser to the President immediately Biden took office. Biden was installed in the White House by Cult manipulation and one of his first decisions was to elevate Fauci to a position of even more control. This is a coincidence? Yes, and I identify as a flamenco dancer called Lola. How does such an incompetent criminal like Fauci remain in that

pivotal position in American health since *the 1980s*? When you serve the Cult it looks after you until you are surplus to requirements. Kary Mullis said prophetically of Fauci and his like: 'Those guys have an agenda and it's not an agenda we would like them to have … they make their own rules, they change them when they want to, and Tony Fauci does not mind going on television in front of the people who pay his salary and lie directly into the camera.' Fauci has done that almost daily since the 'Covid' hoax began. Lying is in Fauci's DNA. To make the situation crystal clear about the PCR test this is a direct quote from its inventor Kary Mullis:

> It [the PCR test] doesn't tell you that you're sick and doesn't tell you that the thing you ended up with was really going to hurt you ...'

Ask yourself why governments and medical systems the world over have been using this very test to decide who is 'infected' with the SARS-CoV-2 'virus' and the alleged disease it allegedly causes, 'Covid-19'. The answer to that question will tell you what has been going on. By the way, here's a little show-stopper – the 'new' SARS-CoV-2 'virus' was 'identified' as such right from the start using … *the PCR test not testing for the 'virus'*. If you are new to this and find that shocking then stick around. I have hardly started yet. Even worse, other 'tests', like the 'Lateral Flow Device' (LFD), are considered so useless that they have to be *confirmed* by the PCR test! Leaked emails written by Ben Dyson, adviser to UK 'Health' Secretary Matt Hancock, said they were 'dangerously unreliable'. Dyson, executive director of strategy at the Department of Health, wrote: 'As of today, someone who gets a positive LFD result in (say) London has at best a 25 per cent chance of it being a true positive, but if it is a self-reported test potentially as low as 10 per cent (on an optimistic assumption about specificity) or as low as 2 per cent (on a more pessimistic assumption).' These are the 'tests' that schoolchildren and the public are being urged to have twice a week or more and have to isolate if they get a positive. Each fake positive goes in the statistics as a 'case' no matter how ludicrously inaccurate and the

'cases' drive lockdown, masks and the pressure to 'vaccinate'. The government said in response to the email leak that the 'tests' were accurate which confirmed yet again what shocking bloody liars they are. The real false positive rate is *100 percent* as we'll see. In another 'you couldn't make it up' the UK government agreed to pay £2.8 billion to California's Innova Medical Group to supply the irrelevant lateral flow tests. The company's primary test-making centre is in China. Innova Medical Group, established in March, 2020, is owned by Pasaca Capital Inc, chaired by Chinese-American millionaire Charles Huang who was born in Wuhan.

How it works – and how it doesn't

The RT-PCR test, known by its full title of Polymerase chain reaction, is used across the world to make millions, even billions, of copies of a DNA/RNA genetic information sample. The process is called 'amplification' and means that a tiny sample of genetic material is amplified to bring out the detailed content. I stress that it is not testing for an infectious disease. It is simply amplifying a sample of genetic material. In the words of Kary Mullis: 'PCR is … just a process that's used to make a whole lot of something out of something.' To emphasise the point companies that make the PCR tests circulated around the world to 'test' for 'Covid' warn on the box that it can't be used to detect 'Covid' or infectious disease and is for research purposes only. It's okay, rest for a minute and you'll be fine. This is the test that produces the 'cases' and 'deaths' that have been used to destroy human society. All those global and national medical and scientific 'experts' demanding this destruction to 'save us' *KNOW* that the test is not testing for the 'virus' and the cases and deaths they claim to be real are an almost unimaginable fraud. Every one of them and so many others including politicians and psychopaths like Gates and Tedros must be brought before Nuremburg-type trials and jailed for the rest of their lives. The more the genetic sample is amplified by PCR the more elements of that material become sensitive to the test and by that I don't mean sensitive for a 'virus' but for elements of the genetic material which

is *naturally* in the body or relates to remnants of old conditions of various kinds lying dormant and causing no disease. Once the amplification of the PCR reaches a certain level *everyone* will test positive. So much of the material has been made sensitive to the test that everyone will have some part of it in their body. Even lying criminals like Fauci have said that once PCR amplifications pass 35 cycles everything will be a false positive that cannot be trusted for the reasons I have described. I say, like many proper doctors and scientists, that 100 percent of the 'positives' are false, but let's just go with Fauci for a moment.

He says that any amplification over 35 cycles will produce false positives and yet the US Centers for Disease Control (CDC) and Food and Drug Administration (FDA) have recommended up to *40 cycles* and the National Health Service (NHS) in Britain admitted in an internal document for staff that it was using *45 cycles* of amplification. A long list of other countries has been doing the same and at least one 'testing' laboratory has been using *50 cycles*. Have you ever heard a doctor, medical 'expert' or the media ask what level of amplification has been used to claim a 'positive'. The 'test' comes back 'positive' and so you have the 'virus', end of story. Now we can see how the government in Tanzania could send off samples from a goat and a pawpaw fruit under human names and both came back positive for 'Covid-19'. Tanzania president John Magufuli mocked the 'Covid' hysteria, the PCR test and masks and refused to import the DNA-manipulating 'vaccine'. The Cult hated him and an article sponsored by the Bill Gates Foundation appeared in the London *Guardian* in February, 2021, headed 'It's time for Africa to rein in Tanzania's anti-vaxxer president'. Well, 'reined in' he shortly was. Magufuli appeared in good health, but then, in March, 2021, he was dead at 61 from 'heart failure'. He was replaced by Samia Hassan Suhulu who is connected to Klaus Schwab's World Economic Forum and she immediately reversed Magufuli's 'Covid' policy. A sample of cola tested positive for 'Covid' with the PCR test in Germany while American actress and singer-songwriter Erykah Badu tested positive in one nostril and negative in the other. Footballer Ronaldo called

the PCR test 'bullshit' after testing positive three times and being forced to quarantine and miss matches when there was nothing wrong with him. The mantra from Tedros at the World Health Organization and national governments (same thing) has been test, test, test. They know that the more tests they can generate the more fake 'cases' they have which go on to become 'deaths' in ways I am coming to. The UK government has its Operation Moonshot planned to test multiple millions every day in workplaces and schools with free tests for everyone to use twice a week at home in line with the Cult plan from the start to make testing part of life. A government advertisement for an 'Interim Head of Asymptomatic Testing Communication' said the job included responsibility for delivering a 'communications strategy' (propaganda) 'to support the expansion of asymptomatic testing that *'normalises testing as part of everyday life*'. More tests means more fake 'cases', 'deaths' and fascism. I have heard of, and from, many people who booked a test, couldn't turn up, and yet got a positive result through the post for a test they'd never even had. The whole thing is crazy, but for the Cult there's method in the madness. Controlling and manipulating the level of amplification of the test means the authorities can control whenever they want the number of apparent 'cases' and 'deaths'. If they want to justify more fascist lockdown and destruction of livelihoods they keep the amplification high. If they want to give the illusion that lockdowns and the 'vaccine' are working then they lower the amplification and 'cases' and 'deaths' will appear to fall. In January, 2021, the Cult-owned World Health Organization suddenly warned laboratories about over-amplification of the test and to lower the threshold. Suddenly headlines began appearing such as: 'Why ARE "Covid" cases plummeting?' This was just when the vaccine rollout was underway and I had predicted months before they would make cases appear to fall through amplification tampering when the 'vaccine' came. These people are so predictable.

Cow vaccines?

The question must be asked of what is on the test swabs being poked far up the nose of the population to the base of the brain? A nasal swab punctured one woman's brain and caused it to leak fluid. Most of these procedures are being done by people with little training or medical knowledge. Dr Lorraine Day, former orthopaedic trauma surgeon and Chief of Orthopaedic Surgery at San Francisco General Hospital, says the tests are really a *'vaccine'*. Cows have long been vaccinated this way. She points out that masks have to cover the nose and the mouth where it is claimed the 'virus' exists in saliva. Why then don't they take saliva from the mouth as they do with a DNA test instead of pushing a long swab up the nose towards the brain? The ethmoid bone separates the nasal cavity from the brain and within that bone is the cribriform plate. Dr Day says that when the swab is pushed up against this plate and twisted the procedure is 'depositing things back there'. She claims that among these 'things' are nanoparticles that can enter the brain. Researchers have noted that a team at the Gates-funded Johns Hopkins have designed tiny, star-shaped micro-devices that can latch onto intestinal mucosa and release drugs into the body. Mucosa is the thin skin that covers the inside surface of parts of the body such as *the nose* and mouth and produces mucus to protect them. The Johns Hopkins micro-devices are called 'theragrippers' and were 'inspired' by a parasitic worm that digs its sharp teeth into a host's intestines. Nasal swabs are also coated in the sterilisation agent ethylene oxide. The US National Cancer Institute posts this explanation on its website:

> At room temperature, ethylene oxide is a flammable colorless gas with a sweet odor. It is used primarily to produce other chemicals, including antifreeze. In smaller amounts, ethylene oxide is used as a pesticide and a sterilizing agent. The ability of ethylene oxide to damage DNA makes it an effective sterilizing agent but also accounts for its cancer-causing activity.

The Institute mentions lymphoma and leukaemia as cancers most frequently reported to be associated with occupational exposure to ethylene oxide along with stomach and breast cancers. How does anyone think this is going to work out with the constant testing

regime being inflicted on adults and children at home and at school that will accumulate in the body anything that's on the swab?

Doctors know best

It is vital for people to realise that 'hero' doctors 'know' only what the Big Pharma-dominated medical authorities tell them to 'know' and if they refuse to 'know' what they are told to 'know' they are out the door. They are mostly not physicians or healers, but repeaters of the official narrative – or else. I have seen alleged professional doctors on British television make shocking statements that we are supposed to take seriously. One called 'Dr' Amir Khan, who is actually telling patients how to respond to illness, said that men could take the birth pill to 'help slow down the effects of Covid-19'. In March, 2021, another ridiculous 'Covid study' by an American doctor proposed injecting men with the female sex hormone progesterone as a 'Covid' treatment. British doctor Nighat Arif told the BBC that face coverings were now going to be part of ongoing normal. Yes, the vaccine protects you, she said (evidence?) … but the way to deal with viruses in the community was always going to come down to hand washing, face covering and keeping a physical distance. That's not what we were told before the 'vaccine' was circulating. Arif said she couldn't imagine ever again going on the underground or in a lift without a mask. I was just thanking my good luck that she was not my doctor when she said – in March, 2021 – that if 'we are *behaving* and we are doing all the right things' she thought we could 'have our nearest and dearest around us at home … around *Christmas* and N*ew Year!* Her patronising delivery was the usual school teacher talking to six-year-olds as she repeated every government talking point and probably believed them all. If we have learned anything from the 'Covid' experience surely it must be that humanity's perception of doctors needs a fundamental rethink. NHS 'doctor' Sara Kayat told her television audience that the 'Covid vaccine' would '100 percent prevent hospitalisation and death'. Not even Big Pharma claimed that. We have to stop taking 'experts' at their word without question when so many of them are

clueless and only repeating the party line on which their careers depend. That is not to say there are not brilliants doctors – there are and I have spoken to many of them since all this began – but you won't see them in the mainstream media or quoted by the psychopaths and yes-people in government.

Remember the name – Christian Drosten

German virologist Christian Drosten, Director of Charité Institute of Virology in Berlin, became a national star after the pandemic hoax began. He was feted on television and advised the German government on 'Covid' policy. Most importantly to the wider world Drosten led a group that produced the 'Covid' testing protocol for the PCR test. What a remarkable feat given the PCR cannot test for infectious disease and even more so when you think that Drosten said that his method of testing for SARS-CoV-2 was developed 'without having virus material available'. *He developed a test for a 'virus' that he didn't have and had never seen*. Let that sink in as you survey the global devastation that came from what he did. The whole catastrophe of Drosten's 'test' was based on the alleged genetic sequence published by Chinese scientists on the Internet. We will see in the next chapter that this alleged 'genetic sequence' has never been produced by China or anyone and cannot be when there *is no* SARS-CoV-2. Drosten, however, doesn't seem to let little details like that get in the way. He was the lead author with Victor Corman from the same Charité Hospital of the paper 'Detection of 2019 novel coronavirus (2019-nCoV) by real-time PCR' published in a magazine called *Eurosurveillance*. This became known as the Corman-Drosten paper. In November, 2020, with human society devastated by the effects of the Corman-Drosten test baloney, the protocol was publicly challenged by 22 international scientists and independent researchers from Europe, the United States, and Japan. Among them were senior molecular geneticists, biochemists, immunologists, and microbiologists. They produced a document headed 'External peer review of the RTPCR test to detect SARS-Cov-2 Reveals 10 Major Flaws At The Molecular and Methodological Level: Consequences

For False-Positive Results'. The flaws in the Corman-Drosten test included the following:

- The test is non-specific because of erroneous design
- Results are enormously variable
- The test is unable to discriminate between the whole 'virus' and viral fragments
- It doesn't have positive or negative controls
- The test lacks a standard operating procedure
- It is unsupported by proper peer view

The scientists said the PCR 'Covid' testing protocol was not founded on science and they demanded the Corman-Drosten paper be retracted by *Eurosurveillance*. They said all present and previous Covid deaths, cases, and 'infection rates' should be subject to a massive retroactive inquiry. Lockdowns and travel restrictions should be reviewed and relaxed and those diagnosed through PCR to have 'Covid-19' should not be forced to isolate. Dr Kevin Corbett, a health researcher and nurse educator with a long academic career producing a stream of peer-reviewed publications at many UK universities, made the same point about the PCR test debacle. He said of the scientists' conclusions: 'Every scientific rationale for the development of that test has been totally destroyed by this paper. It's like Hiroshima/Nagasaki to the Covid test.' He said that China hadn't given them an isolated 'virus' when Drosten developed the test. Instead they had developed the test from *a sequence in a gene bank*.' Put another way … *they made it up*! The scientists were supported in this contention by a Portuguese appeals court which ruled in November, 2020, that PCR tests are unreliable and it is unlawful to quarantine people based solely on a PCR test. The point about China not providing an isolated virus must be true when the 'virus' has never been isolated to this day and the consequences of that will become clear. Drosten and company produced this useless 'protocol' right on cue in January, 2020, just as the 'virus' was said to

be moving westward and it somehow managed to successfully pass a peer-review in 24 hours. In other words there was no peer-review for a test that would be used to decide who had 'Covid' and who didn't across the world. The Cult-created, Gates-controlled World Health Organization immediately recommended all its nearly 200 member countries to use the Drosten PCR protocol to detect 'cases' and 'deaths'. The sting was underway and it continues to this day.

So who is this Christian Drosten that produced the means through which death, destruction and economic catastrophe would be justified? His education background, including his doctoral thesis, would appear to be somewhat shrouded in mystery and his track record is dire as with another essential player in the 'Covid' hoax, the Gates-funded Professor Neil Ferguson at the Gates-funded Imperial College in London of whom more shortly. Drosten predicted in 2003 that the alleged original SARS 'virus' (SARS-1') was an epidemic that could have serious effects on economies and an effective vaccine would take at least two years to produce. Drosten's answer to every alleged 'outbreak' is a vaccine which you won't be shocked to know. What followed were just 774 official deaths worldwide and none in Germany where there were only nine cases. That is even if you believe there ever was a SARS 'virus' when the evidence is zilch and I will expand on this in the next chapter. Drosten claims to be co-discoverer of 'SARS-1' and developed a test for it in 2003. He was screaming warnings about 'swine flu' in 2009 and how it was a widespread infection far more severe than any dangers from a vaccine could be and people should get vaccinated. It would be helpful for Drosten's vocal chords if he simply recorded the words 'the virus is deadly and you need to get vaccinated' and copies could be handed out whenever the latest made-up threat comes along. Drosten's swine flu epidemic never happened, but Big Pharma didn't mind with governments spending hundreds of millions on vaccines that hardly anyone bothered to use and many who did wished they hadn't. A study in 2010 revealed that the risk of dying from swine flu, or H1N1, was no higher than that of the annual seasonal flu which is what at least most of 'it' really was as in

the case of 'Covid-19'. A media investigation into Drosten asked how with such a record of inaccuracy he could be *the* government adviser on these issues. The answer to that question is the same with Drosten, Ferguson and Fauci – they keep on giving the authorities the 'conclusions' and 'advice' they want to hear. Drosten certainly produced the goods for them in January, 2020, with his PCR protocol garbage and provided the foundation of what German internal medicine specialist Dr Claus Köhnlein, co-author of *Virus Mania*, called the 'test pandemic'. The 22 scientists in the *Eurosurveillance* challenge called out conflicts of interest within the Drosten 'protocol' group and with good reason. Olfert Landt, a regular co-author of Drosten 'studies', owns the biotech company TIB Molbiol Syntheselabor GmbH in Berlin which manufactures and sells the tests that Drosten and his mates come up with. They have done this with SARS, Enterotoxigenic E. coli (ETEC), MERS, Zika 'virus', yellow fever, and now 'Covid'. Landt told the *Berliner Zeitung* newspaper:

> The testing, design and development came from the Charité [Drosten and Corman]. We simply implemented it immediately in the form of a kit. And if we don't have the virus, which originally only existed in Wuhan, we can make a synthetic gene to simulate the genome of the virus. That's what we did very quickly.

This is more confirmation that the Drosten test was designed without access to the 'virus' and only a synthetic simulation which is what SARS-CoV-2 really is – a computer-generated synthetic fiction. It's quite an enterprise they have going here. A Drosten team decides what the test for something should be and Landt's biotech company flogs it to governments and medical systems across the world. His company must have made an absolute fortune since the 'Covid' hoax began. Dr Reiner Fuellmich, a prominent German consumer protection trial lawyer in Germany and California, is on Drosten's case and that of Tedros at the World Health Organization for crimes against humanity with a class-action lawsuit being prepared in the United States and other legal action in Germany.

Why China?

Scamming the world with a 'virus' that doesn't exist would seem impossible on the face of it, but not if you have control of the relatively few people that make policy decisions and the great majority of the global media. Remember it's not about changing 'real' reality it's about controlling *perception* of reality. You don't have to make something happen you only have make people *believe* that it's happening. Renegade Minds understand this and are therefore much harder to swindle. 'Covid-19' is not a 'real' 'virus'. It's a mind virus, like a computer virus, which has infected the minds, not the bodies, of billions. It all started, publically at least, in China and that alone is of central significance. The Cult was behind the revolution led by its asset Mao Zedong, or Chairman Mao, which established the People's Republic of China on October 1st, 1949. It should have been called The Cult's Republic of China, but the name had to reflect the recurring illusion that vicious dictatorships are run by and for the people (see all the 'Democratic Republics' controlled by tyrants). In the same way we have the 'Biden' Democratic Republic of America officially ruled by a puppet tyrant (at least temporarily) on behalf of Cult tyrants. The creation of Mao's merciless communist/fascist dictatorship was part of a frenzy of activity by the Cult at the conclusion of World War Two which, like the First World War, it had instigated through its assets in Germany, Britain, France, the United States and elsewhere. Israel was formed in 1948; the Soviet Union expanded its 'Iron Curtain' control, influence and military power with the Warsaw Pact communist alliance in 1955; the United Nations was formed in 1945 as a Cult precursor to world government; and a long list of world bodies would be established including the World Health Organization (1948), World Trade Organization (1948 under another name until 1995), International Monetary Fund (1945) and World Bank (1944). Human society was redrawn and hugely centralised in the global Problem-Reaction-Solution that was World War Two. All these changes were significant. Israel would become the headquarters of the Sabbatians

and the revolution in China would prepare the ground and control system for the events of 2019/2020.

Renegade Minds know there are no borders except for public consumption. The Cult is a seamless, borderless global entity and to understand the game we need to put aside labels like borders, nations, countries, communism, fascism and democracy. These delude the population into believing that countries are ruled within their borders by a government of whatever shade when these are mere agencies of a global power. America's illusion of democracy and China's communism/fascism are subsidiaries – vehicles – for the same agenda. We may hear about conflict and competition between America and China and on the lower levels that will be true; but at the Cult level they are branches of the same company in the way of the McDonald's example I gave earlier. I have tracked in the books over the years support by US governments of both parties for Chinese Communist Party infiltration of American society through allowing the sale of land, even military facilities, and the acquisition of American business and university influence. All this is underpinned by the infamous stealing of intellectual property and technological know-how. Cult-owned Silicon Valley corporations waive their fraudulent 'morality' to do business with human-rights-free China; Cult-controlled Disney has become China's PR department; and China in effect owns 'American' sports such as basketball which depends for much of its income on Chinese audiences. As a result any sports player, coach or official speaking out against China's horrific human rights record is immediately condemned or fired by the China-worshipping National Basketball Association. One of the first acts of China-controlled Biden was to issue an executive order telling federal agencies to stop making references to the 'virus' by the 'geographic location of its origin'. Long-time Congressman Jerry Nadler warned that criticising China, America's biggest rival, leads to hate crimes against Asian people in the United States. So shut up you bigot. China is fast closing in on Israel as a country that must not be criticised which is apt, really, given that Sabbatians control them both. The two countries have

developed close economic, military, technological and strategic ties which include involvement in China's 'Silk Road' transport and economic initiative to connect China with Europe. Israel was the first country in the Middle East to recognise the establishment of Mao's tyranny in 1950 months after it was established.

Project Wuhan – the 'Covid' Psyop

I emphasise again that the Cult plays the long game and what is happening to the world today is the result of centuries of calculated manipulation following a script to take control step-by-step of every aspect of human society. I will discuss later the common force behind all this that has spanned those centuries and thousands of years if the truth be told. Instigating the Mao revolution in China in 1949 with a 2020 'pandemic' in mind is not only how they work – the 71 years between them is really quite short by the Cult's standards of manipulation preparation. The reason for the Cult's Chinese revolution was to create a fiercely-controlled environment within which an extreme structure for human control could be incubated to eventually be unleashed across the world. We have seen this happen since the 'pandemic' emerged from China with the Chinese control-structure founded on AI technology and tyrannical enforcement sweep across the West. Until the moment when the Cult went for broke in the West and put its fascism on public display Western governments had to pay some lip-service to freedom and democracy to not alert too many people to the tyranny-in-the-making. Freedoms were more subtly eroded and power centralised with covert government structures put in place waiting for the arrival of 2020 when that smokescreen of 'freedom' could be dispensed with. The West was not able to move towards tyranny before 2020 anything like as fast as China which was created as a tyranny and had no limits on how fast it could construct the Cult's blueprint for global control. When the time came to impose that structure on the world it was the same Cult-owned Chinese communist/fascist government that provided the excuse – the 'Covid pandemic'. It was absolutely crucial to the Cult plan for the Chinese response to the 'pandemic' –

draconian lockdowns of the entire population – to become the blueprint that Western countries would follow to destroy the livelihoods and freedom of their people. This is why the Cult-owned, Gates-owned, WHO Director-General Tedros said early on:

The Chinese government is to be congratulated for the extraordinary measures it has taken to contain the outbreak. China is actually setting a new standard for outbreak response and it is not an exaggeration.

Forbes magazine said of China: '… those measures protected untold millions from getting the disease'. The Rockefeller Foundation 'epidemic scenario' document in 2010 said 'prophetically':

However, a few countries did fare better – China in particular. The Chinese government's quick imposition and enforcement of mandatory quarantine for all citizens, as well as its instant and near-hermetic sealing off of all borders, saved millions of lives, stopping the spread of the virus far earlier than in other countries and enabling a swifter post-pandemic recovery.

Once again – *spooky*.

The first official story was the 'bat theory' or rather the bat diversion. The source of the 'virus outbreak' we were told was a ''wet market' in Wuhan where bats and other animals are bought and eaten in horrifically unhygienic conditions. Then another story emerged through the alternative media that the 'virus' had been released on purpose or by accident from a BSL-4 (biosafety level 4) laboratory in Wuhan not far from the wet market. The lab was reported to create and work with lethal concoctions and bioweapons. Biosafety level 4 is the highest in the World Health Organization system of safety and containment. Renegade Minds are aware of what I call designer manipulation. The ideal for the Cult is for people to buy its prime narrative which in the opening salvoes of the 'pandemic' was the wet market story. It knows, however, that there is now a considerable worldwide alternative media of researchers sceptical of anything governments say and they are often given a version of events in a form they can perceive as credible while misdirecting them from the real truth. In this case let them

think that the conspiracy involved is a 'bioweapon virus' released from the Wuhan lab to keep them from the real conspiracy – *there is no 'virus'*. The WHO's current position on the source of the outbreak at the time of writing appears to be: 'We haven't got a clue, mate.' This is a good position to maintain mystery and bewilderment. The inner circle will know where the 'virus' came from – *nowhere*. The bottom line was to ensure the public believed there *was* a 'virus' and it didn't much matter if they thought it was natural or had been released from a lab. The belief that there was a 'deadly virus' was all that was needed to trigger global panic and fear. The population was terrified into handing their power to authority and doing what they were told. They had to or they were 'all gonna die'.

In March, 2020, information began to come my way from real doctors and scientists and my own additional research which had my intuition screaming: 'Yes, that's it! *There is no virus*.' The 'bioweapon' was not the 'virus'; it was the *'vaccine'* already being talked about that would be the bioweapon. My conclusion was further enhanced by happenings in Wuhan. The 'virus' was said to be sweeping the city and news footage circulated of people collapsing in the street (which they've never done in the West with the same 'virus'). The Chinese government was building 'new hospitals' in a matter of ten days to 'cope with demand' such was the virulent nature of the 'virus'. Yet in what seemed like no time the 'new hospitals' closed – even if they even opened – and China declared itself 'virus-free'. It was back to business as usual. This was more propaganda to promote the Chinese draconian lockdowns in the West as the way to 'beat the virus'. Trouble was that we subsequently had lockdown after lockdown, but never business as usual. As the people of the West and most of the rest of the world were caught in an ever-worsening spiral of lockdown, social distancing, masks, isolated old people, families forced apart, and livelihood destruction, it was party-time in Wuhan. Pictures emerged of thousands of people enjoying pool parties and concerts. It made no sense until you realised there never was a 'virus' and the

whole thing was a Cult set-up to transform human society out of one its major global strongholds – China.

How is it possible to deceive virtually the entire world population into believing there is a deadly virus when there is not even a 'virus' let alone a deadly one? It's nothing like as difficult as you would think and that's clearly true because it happened.

Postscript: See end of book Postscript for more on the 'Wuhan lab virus release' story which the authorities and media were pushing heavily in the summer of 2021 to divert attention from the truth that the 'Covid virus' is pure invention.

CHAPTER FIVE

There *is no* 'virus'

You can fool some of the people all of the time, and all of the people some of the time, but you cannot fool all of the people all of the time
Abraham Lincoln

The greatest form of mind control is repetition. The more you repeat the same mantra of alleged 'facts' the more will accept them to be true. It becomes an 'everyone knows that, mate'. If you can also censor any other version or alternative to your alleged 'facts' you are pretty much home and cooking.

By the start of 2020 the Cult owned the global mainstream media almost in its entirety to spew out its 'Covid' propaganda and ignore or discredit any other information and view. Cult-owned social media platforms in Cult-owned Silicon Valley were poised and ready to unleash a campaign of ferocious censorship to obliterate all but the official narrative. To complete the circle many demands for censorship by Silicon Valley were led by the mainstream media as 'journalists' became full-out enforcers for the Cult both as propagandists and censors. Part of this has been the influx of young people straight out of university who have become 'journalists' in significant positions. They have no experience and a headful of programmed perceptions from their years at school and university at a time when today's young are the most perceptually-targeted generations in known human history given the insidious impact of technology. They enter the media perceptually prepared and ready to repeat the narratives of the system that programmed them to

repeat its narratives. The BBC has a truly pathetic 'specialist disinformation reporter' called Marianna Spring who fits this bill perfectly. She is clueless about the world, how it works and what is really going on. Her role is to discredit anyone doing the job that a proper journalist would do and system-serving hacks like Spring wouldn't dare to do or even see the need to do. They are too busy licking the arse of authority which can never be wrong and, in the case of the BBC propaganda programme, *Panorama*, contacting payments systems such as PayPal to have a donations page taken down for a film company making documentaries questioning vaccines. Even the BBC soap opera *EastEnders* included a disgracefully biased scene in which an inarticulate white working class woman was made to look foolish for questioning the 'vaccine' while a well-spoken black man and Asian woman promoted the government narrative. It ticked every BBC box and the fact that the black and minority community was resisting the 'vaccine' had nothing to do with the way the scene was written. The BBC has become a disgusting tyrannical propaganda and censorship operation that should be defunded and disbanded and a free media take its place with a brief to stop censorship instead of demanding it. A BBC 'interview' with Gates goes something like: 'Mr Gates, sir, if I can call you sir, would you like to tell our audience why you are such a great man, a wonderful humanitarian philanthropist, and why you should absolutely be allowed as a software salesman to decide health policy for approaching eight billion people? Thank you, sir, please sir.' Propaganda programming has been incessant and merciless and when all you hear is the same story from the media, repeated by those around you who have only heard the same story, is it any wonder that people on a grand scale believe absolute mendacious garbage to be true? You are about to see, too, why this level of information control is necessary when the official 'Covid' narrative is so nonsensical and unsupportable by the evidence.

Structure of Deceit

The pyramid structure through which the 'Covid' hoax has been manifested is very simple and has to be to work. As few people as possible have to be involved with full knowledge of what they are doing – and why – or the real story would get out. At the top of the pyramid are the inner core of the Cult which controls Bill Gates who, in turn, controls the World Health Organization through his pivotal funding and his puppet Director-General mouthpiece, Tedros. Before he was appointed Tedros was chair of the Gates-founded Global Fund to 'fight against AIDS, tuberculosis and malaria', a board member of the Gates-funded 'vaccine alliance' GAVI, and on the board of another Gates-funded organisation. Gates owns him and picked him for a specific reason – Tedros is a crook and worse. 'Dr' Tedros (he's not a medical doctor, the first WHO chief not to be) was a member of the tyrannical Marxist government of Ethiopia for decades with all its human rights abuses. He has faced allegations of corruption and misappropriation of funds and was exposed three times for covering up cholera epidemics while Ethiopia's health minister. Tedros appointed the mass-murdering genocidal Zimbabwe dictator Robert Mugabe as a WHO goodwill ambassador for public health which, as with Tedros, is like appointing a psychopath to run a peace and love campaign. The move was so ridiculous that he had to drop Mugabe in the face of widespread condemnation. American economist David Steinman, a Nobel peace prize nominee, lodged a complaint with the International Criminal Court in The Hague over alleged genocide by Tedros when he was Ethiopia's foreign minister. Steinman says Tedros was a 'crucial decision maker' who directed the actions of Ethiopia's security forces from 2013 to 2015 and one of three officials in charge when those security services embarked on the 'killing' and 'torturing' of Ethiopians. You can see where Tedros is coming from and it's sobering to think that he has been the vehicle for Gates and the Cult to direct the global response to 'Covid'. Think about that. A psychopathic Cult dictates to psychopath Gates who dictates to psychopath Tedros who dictates how countries of the world must respond to a 'Covid virus' never scientifically shown to exist. At the same time psychopathic Cult-owned Silicon Valley information

giants like Google, YouTube, Facebook and Twitter announced very early on that they would give the Cult/Gates/Tedros/WHO version of the narrative free advertising and censor those who challenged their intelligence-insulting, mendacious story.

The next layer in the global 'medical' structure below the Cult, Gates and Tedros are the chief medical officers and science 'advisers' in each of the WHO member countries which means virtually all of them. Medical officers and arbiters of science (they're not) then take the WHO policy and recommended responses and impose them on their country's population while the political 'leaders' say they are deciding policy (they're clearly not) by 'following the science' on the advice of the 'experts' – the same medical officers and science 'advisers' (dictators). In this way with the rarest of exceptions the entire world followed the same policy of lockdown, people distancing, masks and 'vaccines' dictated by the psychopathic Cult, psychopathic Gates and psychopathic Tedros who we are supposed to believe give a damn about the health of the world population they are seeking to enslave. That, amazingly, is all there is to it in terms of crucial decision-making. Medical staff in each country then follow like sheep the dictates of the shepherds at the top of the national medical hierarchies – chief medical officers and science 'advisers' who themselves follow like sheep the shepherds of the World Health Organization and the Cult. Shepherds at the national level often have major funding and other connections to Gates and his Bill and Melinda Gates Foundation which carefully hands out money like confetti at a wedding to control the entire global medical system from the WHO down.

Follow the money

Christopher Whitty, Chief Medical Adviser to the UK Government at the centre of 'virus' policy, a senior adviser to the government's Scientific Advisory Group for Emergencies (SAGE), and Executive Board member of the World Health Organization, was gifted a grant of $40 million by the Bill and Melinda Gates Foundation for malaria research in Africa. The BBC described the unelected Whitty as 'the

official who will probably have the greatest impact on our everyday lives of any individual policymaker in modern times' and so it turned out. What Gates and Tedros have said Whitty has done like his equivalents around the world. Patrick Vallance, co-chair of SAGE and the government's Chief Scientific Adviser, is a former executive of Big Pharma giant GlaxoSmithKline with its fundamental financial and business connections to Bill Gates. In September, 2020, it was revealed that Vallance owned a deferred bonus of shares in GlaxoSmithKline worth £600,000 while the company was 'developing' a 'Covid vaccine'. Move along now – nothing to see here – what could possibly be wrong with that? Imperial College in London, a major player in 'Covid' policy in Britain and elsewhere with its 'Covid-19' Response Team, is funded by Gates and has big connections to China while the now infamous Professor Neil Ferguson, the useless 'computer modeller' at Imperial College is also funded by Gates. Ferguson delivered the dramatically inaccurate excuse for the first lockdowns (much more in the next chapter). The Institute for Health Metrics and Evaluation (IHME) in the United States, another source of outrageously false 'Covid' computer models to justify lockdowns, is bankrolled by Gates who is a vehement promotor of lockdowns. America's version of Whitty and Vallance, the again now infamous Anthony Fauci, has connections to 'Covid vaccine' maker Moderna as does Bill Gates through funding from the Bill and Melinda Gates Foundation. Fauci is director of the National Institute of Allergy and Infectious Diseases (NIAID), a major recipient of Gates money, and they are very close. Deborah Birx who was appointed White House Coronavirus Response Coordinator in February, 2020, is yet another with ties to Gates. Everywhere you look at the different elements around the world behind the coordination and decision making of the 'Covid' hoax there is Bill Gates and his money. They include the World Health Organization; Centers for Disease Control (CDC) in the United States; National Institutes of Health (NIH) of Anthony Fauci; Imperial College and Neil Ferguson; the London School of Hygiene where Chris Whitty worked; Regulatory agencies like the UK Medicines & Healthcare products Regulatory Agency (MHRA)

which gave emergency approval for 'Covid vaccines'; Wellcome Trust; GAVI, the Vaccine Alliance; the Coalition for Epidemic Preparedness Innovations (CEPI); Johns Hopkins University which has compiled the false 'Covid' figures; and the World Economic Forum. A Nationalfile.com article said:

> Gates has a lot of pull in the medical world, he has a multi-million dollar relationship with Dr. Fauci, and Fauci originally took the Gates line supporting vaccines and casting doubt on [the drug hydroxychloroquine]. Coronavirus response team member Dr. Deborah Birx, appointed by former president Obama to serve as United States Global AIDS Coordinator, also sits on the board of a group that has received billions from Gates' foundation, and Birx reportedly used a disputed Bill Gates-funded model for the White House's Coronavirus effort. Gates is a big proponent for a population lockdown scenario for the Coronavirus outbreak.

Another funder of Moderna is the Defense Advanced Research Projects Agency (DARPA), the technology-development arm of the Pentagon and one of the most sinister organisations on earth. DARPA had a major role with the CIA covert technology-funding operation In-Q-Tel in the development of Google and social media which is now at the centre of global censorship. Fauci and Gates are extremely close and openly admit to talking regularly about 'Covid' policy, but then why wouldn't Gates have a seat at every national 'Covid' table after his Foundation committed $1.75 billion to the 'fight against Covid-19'. When passed through our Orwellian Translation Unit this means that he has bought and paid for the Cult-driven 'Covid' response worldwide. Research the major 'Covid' response personnel in your own country and you will find the same Gates funding and other connections again and again. Medical and science chiefs following World Health Organization 'policy' sit atop a medical hierarchy in their country of administrators, doctors and nursing staff. These 'subordinates' are told they must work and behave in accordance with the policy delivered from the 'top' of the national 'health' pyramid which is largely the policy delivered by the WHO which is the policy delivered by Gates and the Cult. The whole 'Covid' narrative has been imposed on medical staff by a climate of fear although great numbers don't even need that to comply. They do so through breathtaking levels of ignorance and

include doctors who go through life simply repeating what Big Pharma and their hierarchical masters tell them to say and believe. No wonder Big Pharma 'medicine' is one of the biggest killers on Planet Earth.

The same top-down system of intimidation operates with regard to the Cult Big Pharma cartel which also dictates policy through national and global medical systems in this way. The Cult and Big Pharma agendas are the same because the former controls and owns the latter. 'Health' administrators, doctors, and nursing staff are told to support and parrot the dictated policy or they will face consequences which can include being fired. How sad it's been to see medical staff meekly repeating and imposing Cult policy without question and most of those who can see through the deceit are only willing to speak anonymously off the record. They know what will happen if their identity is known. This has left the courageous few to expose the lies about the 'virus', face masks, overwhelmed hospitals that aren't, and the dangers of the 'vaccine' that isn't a vaccine. When these medical professionals and scientists, some renowned in their field, have taken to the Internet to expose the truth their articles, comments and videos have been deleted by Cult-owned Facebook, Twitter and YouTube. What a real head-shaker to see YouTube videos with leading world scientists and highly qualified medical specialists with an added link underneath to the notorious Cult propaganda website *Wikipedia* to find the 'facts' about the same subject.

HIV – the 'Covid' trial-run

I'll give you an example of the consequences for health and truth that come from censorship and unquestioning belief in official narratives. The story was told by PCR inventor Kary Mullis in his book *Dancing Naked in the Mind Field*. He said that in 1984 he accepted as just another scientific fact that Luc Montagnier of France's Pasteur Institute and Robert Gallo of America's National Institutes of Health had independently discovered that a 'retrovirus' dubbed HIV (human immunodeficiency virus) caused AIDS. They

were, after all, Mullis writes, specialists in retroviruses. This is how the medical and science pyramids work. Something is announced or *assumed* and then becomes an everybody-knows-that purely through repetition of the assumption as if it is fact. Complete crap becomes accepted truth with no supporting evidence and only repetition of the crap. This is how a 'virus' that doesn't exist became the 'virus' that changed the world. The HIV-AIDS fairy story became a multi-billion pound industry and the media poured out propaganda terrifying the world about the deadly HIV 'virus' that caused the lethal AIDS. By then Mullis was working at a lab in Santa Monica, California, to detect retroviruses with his PCR test in blood donations received by the Red Cross. In doing so he asked a virologist where he could find a reference for HIV being the cause of AIDS. 'You don't need a reference,' the virologist said … *'Everybody knows it.'* Mullis said he wanted to quote a reference in the report he was doing and he said he felt a little funny about not knowing the source of such an important discovery when everyone else seemed to. The virologist suggested he cite a report by the Centers for Disease Control and Prevention (CDC) on morbidity and mortality. Mullis read the report, but it only said that an organism had been identified and did not say how. The report did not identify the original scientific work. Physicians, however, *assumed* (key recurring theme) that if the CDC was convinced that HIV caused AIDS then proof must exist. Mullis continues:

I did computer searches. Neither Montagnier, Gallo, nor anyone else had published papers describing experiments which led to the conclusion that HIV probably caused AIDS. I read the papers in Science for which they had become well known as AIDS doctors, but all they had said there was that they had found evidence of a past infection by something which was probably HIV in some AIDS patients.

They found antibodies. Antibodies to viruses had always been considered evidence of past disease, not present disease. Antibodies signaled that the virus had been defeated. The patient had saved himself. There was no indication in these papers that this virus caused a disease. They didn't show that everybody with the antibodies had the disease. In fact they found some healthy people with antibodies.

Mullis asked why their work had been published if Montagnier and Gallo hadn't really found this evidence, and why had they been fighting so hard to get credit for the discovery? He says he was hesitant to write 'HIV is the probable cause of AIDS' until he found published evidence to support that. 'Tens of thousands of scientists and researchers were spending billions of dollars a year doing research based on this idea,' Mullis writes. 'The reason had to be there somewhere; otherwise these people would not have allowed their research to settle into one narrow channel of investigation.' He said he lectured about PCR at numerous meetings where people were always talking about HIV and he asked them how they knew that HIV was the cause of AIDS:

> Everyone said something. Everyone had the answer at home, in the office, in some drawer. They all knew, and they would send me the papers as soon as they got back. But I never got any papers. Nobody ever sent me the news about how AIDS was caused by HIV.

Eventually Mullis was able to ask Montagnier himself about the reference proof when he lectured in San Diego at the grand opening of the University of California AIDS Research Center. Mullis says this was the last time he would ask his question without showing anger. Montagnier said he should reference the CDC report. 'I read it', Mullis said, and it didn't answer the question. 'If Montagnier didn't know the answer who the hell did?' Then one night Mullis was driving when an interview came on National Public Radio with Peter Duesberg, a prominent virologist at Berkeley and a California Scientist of the Year. Mullis says he finally understood why he could not find references that connected HIV to AIDS – *there weren't any!* No one had ever proved that HIV causes AIDS even though it had spawned a multi-billion pound global industry and the media was repeating this as fact every day in their articles and broadcasts terrifying the shit out of people about AIDS and giving the impression that a positive test for HIV (see 'Covid') was a death sentence. Duesberg was a threat to the AIDS gravy train and the agenda that underpinned it. He was therefore abused and castigated after he told the Proceedings of the National Academy of Sciences

there was no good evidence implicating the new 'virus'. Editors rejected his manuscripts and his research funds were deleted. Mullis points out that the CDC has defined AIDS as one of more than 30 diseases *if accompanied* by a positive result on a test that detects antibodies to HIV; but those same diseases are not defined as AIDS cases when antibodies are not detected:

> If an HIV-positive woman develops uterine cancer, for example, she is considered to have AIDS. If she is not HIV positive, she simply has uterine cancer. An HIV-positive man with tuberculosis has AIDS; if he tests negative he simply has tuberculosis. If he lives in Kenya or Colombia, where the test for HIV antibodies is too expensive, he is simply presumed to have the antibodies and therefore AIDS, and therefore he can be treated in the World Health Organization's clinic. It's the only medical help available in some places. And it's free, because the countries that support WHO are worried about AIDS.

Mullis accuses the CDC of continually adding new diseases (see ever more 'Covid symptoms') to the grand AIDS definition and of virtually doctoring the books to make it appear as if the disease continued to spread. He cites how in 1993 the CDC enormously broadened its AIDS definition and county health authorities were delighted because they received $2,500 per year from the Federal government for every reported AIDS case. Ladies and gentlemen, I have just described, via Kary Mullis, the 'Covid pandemic' of 2020 and beyond. Every element is the same and it's been pulled off in the same way by the same networks.

The 'Covid virus' exists? Okay – prove it. Er … still waiting

What Kary Mullis described with regard to 'HIV' has been repeated with 'Covid'. A claim is made that a new, or 'novel', infection has been found and the entire medical system of the world repeats that as fact exactly as they did with HIV and AIDS. No one in the mainstream asks rather relevant questions such as 'How do you know?' and 'Where is your proof?' The SARS-Cov-2 'virus' and the 'Covid-19 disease' became an overnight 'everybody-knows-that'. The origin could be debated and mulled over, but what you could not suggest was that 'SARS-Cov-2' didn't exist. That would be

ridiculous. 'Everybody knows' the 'virus' exists. Well, I didn't for one along with American proper doctors like Andrew Kaufman and Tom Cowan and long-time American proper journalist Jon Rappaport. We dared to pursue the obvious and simple question: 'Where's the evidence?' The overwhelming majority in medicine, journalism and the general public did not think to ask that. After all, *everyone knew* there was a new 'virus'. Everyone was saying so and I heard it on the BBC. Some would eventually argue that the 'deadly virus' was nothing like as deadly as claimed, but few would venture into the realms of its very existence. Had they done so they would have found that the evidence for that claim had gone AWOL as with HIV causes AIDS. In fact, not even that. For something to go AWOL it has to exist in the first place and scientific proof for a 'SARS-Cov-2' can be filed under nothing, nowhere and zilch.

Dr Andrew Kaufman is a board-certified forensic psychiatrist in New York State, a Doctor of Medicine and former Assistant Professor and Medical Director of Psychiatry at SUNY Upstate Medical University, and Medical Instructor of Hematology and Oncology at the Medical School of South Carolina. He also studied biology at the Massachusetts Institute of Technology (MIT) and trained in Psychiatry at Duke University. Kaufman is retired from allopathic medicine, but remains a consultant and educator on natural healing, I saw a video of his very early on in the 'Covid' hoax in which he questioned claims about the 'virus' in the absence of any supporting evidence and with plenty pointing the other way. I did everything I could to circulate his work which I felt was asking the pivotal questions that needed an answer. I can recommend an excellent pull-together interview he did with the website The Last Vagabond entitled *Dr Andrew Kaufman: Virus Isolation, Terrain Theory and Covid-19* and his website is andrewkaufmanmd.com. Kaufman is not only a forensic psychiatrist; he is forensic in all that he does. He always reads original scientific papers, experiments and studies instead of second-third-fourth-hand reports about the 'virus' in the media which are repeating the repeated repetition of the narrative. When he did so with the original Chinese 'virus' papers Kaufman

realised that there was no evidence of a 'SARS-Cov-2'. They had never – from the start – shown it to exist and every repeat of this claim worldwide was based on the accepted existence of proof that was nowhere to be found – see Kary Mullis and HIV. Here we go again.

Let's postulate

Kaufman discovered that the Chinese authorities immediately concluded that the cause of an illness that broke out among about 200 initial patients in Wuhan was a 'new virus' when there were no grounds to make that conclusion. The alleged 'virus' was not isolated from other genetic material in their samples and then shown through a system known as Koch's postulates to be the causative agent of the illness. The world was told that the SARS-Cov-2 'virus' caused a disease they called 'Covid-19' which had 'flu-like' symptoms and could lead to respiratory problems and pneumonia. If it wasn't so tragic it would almost be funny. *'Flu-like' symptoms'? Pneumonia? Respiratory disease?* What in *CHINA* and particularly in *Wuhan*, one of the most polluted cities in the world with a resulting epidemic of respiratory disease?? Three hundred thousand people get pneumonia in China every year and there are nearly a billion cases worldwide of 'flu-like symptoms'. These have a whole range of causes – including pollution in Wuhan – but no other possibility was credibly considered in late 2019 when the world was told there was a new and deadly 'virus'. The global prevalence of pneumonia and 'flu-like systems' gave the Cult networks unlimited potential to re-diagnose these other causes as the mythical 'Covid-19' and that is what they did from the very start. Kaufman revealed how Chinese medical and science authorities (all subordinates to the Cult-owned communist government) took genetic material from the lungs of only a few of the first patients. The material contained their own cells, bacteria, fungi and other microorganisms living in their bodies. The only way you could prove the existence of the 'virus' and its responsibility for the alleged 'Covid-19' was to isolate the virus from all the other material – a process also known as 'purification' – and

then follow the postulates sequence developed in the late 19th century by German physician and bacteriologist Robert Koch which became the 'gold standard' for connecting an alleged causation agent to a disease:

1. The microorganism (bacteria, fungus, virus, etc.) must be present in every case of the disease and all patients must have the same symptoms. It must also *not be present in healthy individuals*.

2. The microorganism must be isolated from the host with the disease. If the microorganism is a bacteria or fungus it must be grown in a pure culture. If it is a virus, it must be purified (i.e. containing no other material except the virus particles) from a clinical sample.

3. The specific disease, with all of its characteristics, must be reproduced when the infectious agent (the purified virus or a pure culture of bacteria or fungi) is inoculated into a healthy, susceptible host.

4. The microorganism must be recoverable from the experimentally infected host as in step 2.

Not one of these criteria has been met in the case of 'SARS-Cov-2' and 'Covid-19'. Not ONE. *EVER*. Robert Koch refers to bacteria and not viruses. What are called 'viral particles' are so minute (hence masks are useless by any definition) that they could only be seen after the invention of the electron microscope in the 1930s and can still only be observed through that means. American bacteriologist and virologist Thomas Milton Rivers, the so-called 'Father of Modern Virology' who was very significantly director of the Rockefeller Institute for Medical Research in the 1930s, developed a less stringent version of Koch's postulates to identify 'virus' causation known as 'Rivers criteria'. 'Covid' did not pass that process either. Some even doubt whether any 'virus' can be isolated from other particles containing genetic material in the Koch method. Freedom of Information requests in many countries asking for scientific proof that the 'Covid virus' has been purified and isolated and shown to exist have all come back with a 'we don't have that' and when this happened with a request to the UK Department of Health they added this comment:

However, outside of the scope of the [Freedom of Information Act] and on a discretionary basis, the following information has been advised to us, which may be of interest. Most infectious diseases are caused by viruses, bacteria or fungi. Some bacteria or fungi have the capacity to grow on their own in isolation, for example in colonies on a petri dish. Viruses are different in that they are what we call 'obligate pathogens' – that is, they cannot survive or reproduce without infecting a host ...

… For some diseases, it is possible to establish causation between a microorganism and a disease by isolating the pathogen from a patient, growing it in pure culture and reintroducing it to a healthy organism. These are known as 'Koch's postulates' and were developed in 1882. However, as our understanding of disease and different disease-causing agents has advanced, these are no longer the method for determining causation [Andrew Kaufman asks why in that case are there two published articles falsely claiming to satisfy Koch's postulates].

It has long been known that viral diseases cannot be identified in this way as viruses cannot be grown in 'pure culture'. When a patient is tested for a viral illness, this is normally done by looking for the presence of antigens, or viral genetic code in a host with molecular biology techniques [Kaufman asks how you could know the origin of these chemicals without having a pure culture for comparison].

For the record 'antigens' are defined so:

Invading microorganisms have antigens on their surface that the human body can recognise as being foreign – meaning not belonging to it. When the body recognises a foreign antigen, lymphocytes (white blood cells) produce antibodies, which are complementary in shape to the antigen.

Notwithstanding that this is open to question in relation to 'SARS-Cov-2' the presence of 'antibodies' can have many causes and they are found in people that are perfectly well. Kary Mullis said: 'Antibodies … had always been considered evidence of past disease, not present disease.'

'Covid' really is a *computer* 'virus'

Where the UK Department of Health statement says 'viruses' are now 'diagnosed' through a 'viral genetic code in a host with molecular biology techniques', they mean … *the PCR test* which its inventor said cannot test for infectious disease. They have no credible method of connecting a 'virus' to a disease and we will see that there is no scientific proof that any 'virus' causes any disease or there is any such thing as a 'virus' in the way that it is described. Tenacious Canadian researcher Christine Massey and her team made

some 40 Freedom of Information requests to national public health agencies in different countries asking for proof that SARS-CoV-2 has been isolated and not one of them could supply that information. Massey said of her request in Canada: 'Freedom of Information reveals Public Health Agency of Canada has no record of 'SARS-COV-2' isolation performed by anyone, anywhere, ever.' If you accept the comment from the UK Department of Health it's because they can't isolate a 'virus'. Even so many 'science' papers claimed to have isolated the 'Covid virus' until they were questioned and had to admit they hadn't. A reply from the Robert Koch Institute in Germany was typical: 'I am not aware of a paper which purified isolated SARS-CoV-2.' So what the hell was Christian Drosten and his gang using to design the 'Covid' testing protocol that has produced all the illusory Covid' cases and 'Covid' deaths when the head of the Chinese version of the CDC admitted there was a problem right from the start in that the 'virus' had never been isolated/purified? Breathe deeply: What they are calling 'Covid' is actually created by a *computer program* i.e. *they made it up* – er, that's it. They took lung fluid, with many sources of genetic material, from one single person alleged to be infected with Covid-19 by a PCR test which they *claimed*, without clear evidence, contained a 'virus'. They used several computer programs to create a model of a theoretical virus genome sequence from more than fifty-six million small sequences of RNA, each of an unknown source, assembling them like a puzzle with no known solution. The computer filled in the gaps with sequences from bits in the gene bank to make it look like a bat SARS-like coronavirus! A wave of the magic wand and poof, an in silico (computer-generated) genome, a scientific fantasy, was created. UK health researcher Dr Kevin Corbett made the same point with this analogy:

> … It's like giving you a few bones and saying that's your fish. It could be any fish. Not even a skeleton. Here's a few fragments of bones. That's your fish … It's all from gene bank and the bits of the virus sequence that weren't there they made up.
>
> They synthetically created them to fill in the blanks. That's what genetics is; it's a code. So it's ABBBCCDDD and you're missing some what you think is EEE so you put it in. It's all

synthetic. You just manufacture the bits that are missing. This is the end result of the geneticization of virology. This is basically a computer virus.

Further confirmation came in an email exchange between British citizen journalist Frances Leader and the government's Medicines & Healthcare Products Regulatory Agency (the Gates-funded MHRA) which gave emergency permission for untested 'Covid vaccines' to be used. The agency admitted that the 'vaccine' is not based on an isolated 'virus', but comes from a *computer-generated model*. Frances Leader was naturally banned from Cult-owned fascist Twitter for making this exchange public. The process of creating computer-generated alleged 'viruses' is called 'in silico' or 'in silicon' – computer chips – and the term 'in silico' is believed to originate with biological experiments using only a computer in 1989. 'Vaccines' involved with 'Covid' are also produced 'in silico' or by computer not a natural process. If the original 'virus' is nothing more than a made-up computer model how can there be 'new variants' of something that never existed in the first place? They are not new 'variants'; they are new *computer models* only minutely different to the original program and designed to further terrify the population into having the 'vaccine' and submitting to fascism. You want a 'new variant'? Click, click, enter – there you go. Tell the medical profession that you have discovered a 'South African variant', 'UK variants' or a 'Brazilian variant' and in the usual HIV-causes-AIDS manner they will unquestioningly repeat it with no evidence whatsoever to support these claims. They will go on television and warn about the dangers of 'new variants' while doing nothing more than repeating what they have been told to be true and knowing that any deviation from that would be career suicide. Big-time insiders will know it's a hoax, but much of the medical community is clueless about the way they are being played and themselves play the public without even being aware they are doing so. What an interesting 'coincidence' that AstraZeneca and Oxford University were conducting 'Covid vaccine trials' in the three countries – the UK, South Africa and Brazil – where the first three 'variants' were claimed to have 'broken out'.

Here's your 'virus' – it's a unicorn

Dr Andrew Kaufman presented a brilliant analysis describing how the 'virus' was imagined into fake existence when he dissected an article published by *Nature* and written by 19 authors detailing *alleged* 'sequencing of a complete viral genome' of the 'new SARS-CoV-2 virus'. This computer-modelled *in silico* genome was used as a template for all subsequent genome sequencing experiments that resulted in the so-called variants which he said now number more than *6,000*. The fake genome was constructed from more than 56 million individual short strands of RNA. Those little pieces were assembled into longer pieces by finding areas of overlapping sequences. The computer programs created over two million possible combinations from which the authors simply chose the longest one. They then compared this to a 'bat virus' and the computer 'alignment' rearranged the sequence and filled in the gaps! They called this computer-generated abomination the 'complete genome'. Dr Tom Cowan, a fellow medical author and collaborator with Kaufman, said such computer-generation constitutes scientific fraud and he makes this superb analogy:

> Here is an equivalency: A group of researchers claim to have found a unicorn because they found a piece of a hoof, a hair from a tail, and a snippet of a horn. They then add that information into a computer and program it to re-create the unicorn, and they then claim this computer re-creation is the real unicorn. Of course, they had never actually seen a unicorn so could not possibly have examined its genetic makeup to compare their samples with the actual unicorn's hair, hooves and horn.
>
> The researchers claim they decided which is the real genome of SARS-CoV-2 by 'consensus', sort of like a vote. Again, different computer programs will come up with different versions of the imaginary 'unicorn', so they come together as a group and decide which is the real imaginary unicorn.

This is how the 'virus' that has transformed the world was brought into fraudulent 'existence'. Extraordinary, yes, but as the Nazis said the bigger the lie the more will believe it. Cowan, however, wasn't finished and he went on to identify what he called the real blockbuster in the paper. He quotes this section from a paper written

by virologists and published by the CDC and then explains what it means:

Therefore, we examined the capacity of SARS-CoV-2 to infect and replicate in several common primate and human cell lines, including human adenocarcinoma cells (A549), human liver cells (HUH 7.0), and human embryonic kidney cells (HEK-293T). In addition to Vero E6 and Vero CCL81 cells. ... Each cell line was inoculated at high multiplicity of infection and examined 24h post-infection.

No CPE was observed in any of the cell lines except in Vero cells, which grew to greater than 10 to the 7th power at 24 h post-infection. In contrast, HUH 7.0 and 293T showed only modest viral replication, and A549 cells were incompatible with SARS CoV-2 infection.

Cowan explains that when virologists attempt to prove infection they have three possible 'hosts' or models on which they can test. The first was humans. Exposure to humans was generally not done for ethical reasons and has never been done with SARS-CoV-2 or any coronavirus. The second possible host was animals. Cowan said that forgetting for a moment that they never actually use purified virus when exposing animals they do use solutions that they *claim* contain the virus. Exposure to animals has been done with SARS-CoV-2 in an experiment involving mice and this is what they found: *None of the wild (normal) mice got sick*. In a group of genetically-modified mice, a statistically insignificant number lost weight and had slightly bristled fur, but they experienced nothing like the illness called 'Covid-19'. Cowan said the third method – the one they mostly rely on – is to inoculate solutions they *say* contain the virus onto a variety of tissue cultures. This process had never been shown to kill tissue *unless* the sample material was starved of nutrients and poisoned as *part of the process*. Yes, incredibly, in tissue experiments designed to show the 'virus' is responsible for killing the tissue they starve the tissue of nutrients and add toxic drugs including antibiotics and they do not have control studies to see if it's the starvation and poisoning that is degrading the tissue rather than the 'virus' they allege to be in there somewhere. You want me to pinch you? Yep, I understand. Tom Cowan said this about the whole nonsensical farce as he explains what that quote from the CDC paper really means:

The shocking thing about the above quote is that using their own methods, the virologists found that solutions containing SARS-CoV-2 – even in high amounts – were NOT, I repeat NOT, infective to any of the three human tissue cultures they tested. In plain English, this means they proved, on their terms, that this 'new coronavirus' is not infectious to human beings. It is ONLY infective to monkey kidney cells, and only then when you add two potent drugs (gentamicin and amphotericin), known to be toxic to kidneys, to the mix.

My friends, read this again and again. These virologists, published by the CDC, performed a clear proof, on their terms, showing that the SARS-CoV-2 virus is harmless to human beings. That is the only possible conclusion, but, unfortunately, this result is not even mentioned in their conclusion. They simply say they can provide virus stocks cultured only on monkey Vero cells, thanks for coming.

Cowan concluded: 'If people really understood how this "science" was done, I would hope they would storm the gates and demand honesty, transparency and truth.' Dr Michael Yeadon, former Vice President and Chief Scientific Adviser at drug giant Pfizer has been a vocal critic of the 'Covid vaccine' and its potential for multiple harm. He said in an interview in April, 2021, that 'not one [vaccine] has the virus. He was asked why vaccines normally using a 'dead' version of a disease to activate the immune system were not used for 'Covid' and instead we had the synthetic methods of the 'mRNA Covid vaccine'. Yeadon said that to do the former 'you'd have to have some of [the virus] wouldn't you?' He added: 'No-one's got any – seriously.' Yeadon said that surely they couldn't have fooled the whole world for a year without having a virus, 'but oddly enough ask around – no one's got it'. He didn't know why with all the 'great labs' around the world that the virus had not been isolated – 'Maybe they've been too busy running bad PCR tests and vaccines that people don't need.' What is today called 'science' is not 'science' at all. Science is no longer what is, but whatever people can be manipulated to *believe* that it is. Real science has been hijacked by the Cult to dispense and produce the 'expert scientists' and contentions that suit the agenda of the Cult. How big-time this has happened with the 'Covid' hoax which is entirely based on fake science delivered by fake 'scientists' and fake 'doctors'. The human-caused climate change hoax is also entirely based on fake science delivered by fake 'scientists' and fake 'climate experts'. In both cases real

scientists, climate experts and doctors have their views suppressed and deleted by the Cult-owned science establishment, media and Silicon Valley. This is the 'science' that politicians claim to be 'following' and a common denominator of 'Covid' and climate are Cult psychopaths Bill Gates and his mate Klaus Schwab at the Gates-funded World Economic Forum. But, don't worry, it's all just a coincidence and absolutely nothing to worry about. *Zzzzzzzz*.

What is a 'virus' REALLY?

Dr Tom Cowan is one of many contesting the very existence of viruses let alone that they cause disease. This is understandable when there is no scientific evidence for a disease-causing 'virus'. German virologist Dr Stefan Lanka won a landmark case in 2017 in the German Supreme Court over his contention that there is no such thing as a measles virus. He had offered a big prize for anyone who could prove there is and Lanka won his case when someone sought to claim the money. There is currently a prize of more than 225,000 euros on offer from an Isolate Truth Fund for anyone who can prove the isolation of SARS-CoV-2 and its genetic substance. Lanka wrote in an article headed 'The Misconception Called Virus' that scientists think a 'virus' is causing tissue to become diseased and degraded when in fact it is the *processes they are using* which do that – not a 'virus'. Lanka has done an important job in making this point clear as Cowan did in his analysis of the CDC paper. Lanka says that all claims about viruses as disease-causing pathogens are wrong and based on 'easily recognisable, understandable and verifiable misinterpretations.' Scientists believed they were working with 'viruses' in their laboratories when they were really working with 'typical particles of specific dying tissues or cells …' Lanka said that the tissue decaying process claimed to be caused by a 'virus' still happens when no alleged 'virus' is involved. It's the *process* that does the damage and not a 'virus'. The genetic sample is deprived of nutrients, removed from its energy supply through removal from the body and then doused in toxic antibiotics to remove any bacteria. He confirms again that establishment scientists do not (pinch me)

conduct control experiments to see if this is the case and if they did they would see the claims that 'viruses' are doing the damage is nonsense. He adds that during the measles 'virus' court case he commissioned an independent laboratory to perform just such a control experiment and the result was that the tissues and cells died in the exact same way as with alleged 'infected' material. This is supported by a gathering number of scientists, doctors and researchers who reject what is called 'germ theory' or the belief in the body being infected by contagious sources emitted by other people. Researchers Dawn Lester and David Parker take the same stance in their highly-detailed and sourced book *What Really Makes You Ill – Why everything you thought you knew about disease is wrong* which was recommended to me by a number of medical professionals genuinely seeking the truth. Lester and Parker say there is no provable scientific evidence to show that a 'virus' can be transmitted between people or people and animals or animals and people:

> The definition also claims that viruses are the cause of many diseases, as if this has been definitively proven. But this is not the case; there is no original scientific evidence that definitively demonstrates that any virus is the cause of any disease. The burden of proof for any theory lies with those who proposed it; but none of the existing documents provides 'proof' that supports the claim that 'viruses' are pathogens.

Dr Tom Cowan employs one of his clever analogies to describe the process by which a 'virus' is named as the culprit for a disease when what is called a 'virus' is only material released by cells detoxing themselves from infiltration by chemical or radiation poisoning. The tidal wave of technologically-generated radiation in the 'smart' modern world plus all the toxic food and drink are causing this to happen more than ever. Deluded 'scientists' misread this as a gathering impact of what they wrongly label 'viruses'.

Paper can infect houses

Cowan said in an article for davidicke.com – with his tongue only mildly in his cheek – that he believed he had made a tremendous

discovery that may revolutionise science. He had discovered that small bits of paper are alive, 'well alive-ish', can 'infect' houses, and then reproduce themselves inside the house. The result was that this explosion of growth in the paper inside the house causes the house to explode, blowing it to smithereens. His evidence for this new theory is that in the past months he had carefully examined many of the houses in his neighbourhood and found almost no scraps of paper on the lawns and surrounds of the house. There was an occasional stray label, but nothing more. Then he would return to these same houses a week or so later and with a few, not all of them, particularly the old and decrepit ones, he found to his shock and surprise they were littered with stray bits of paper. He knew then that the paper had infected these houses, made copies of itself, and blew up the house. A young boy on a bicycle at one of the sites told him he had seen a demolition crew using dynamite to explode the house the previous week, but Cowan dismissed this as the idle thoughts of silly boys because 'I was on to something big'. He was on to how 'scientists' mistake genetic material in the detoxifying process for something they call a 'virus'. Cowan said of his house and paper story:

> If this sounds crazy to you, it's because it should. This scenario is obviously nuts. But consider this admittedly embellished, for effect, current viral theory that all scientists, medical doctors and virologists currently believe.

He takes the example of the 'novel SARS-Cov2' virus to prove the point. First they take someone with an undefined illness called 'Covid-19' and don't even attempt to find any virus in their sputum. Never mind the scientists still describe how this 'virus', which they have not located attaches to a cell receptor, injects its genetic material, in 'Covid's' case, RNA, into the cell. The RNA once inserted exploits the cell to reproduce itself and makes 'thousands, nay millions, of copies of itself … Then it emerges victorious to claim its next victim':

If you were to look in the scientific literature for proof, actual scientific proof, that uniform SARS-CoV2 viruses have been properly isolated from the sputum of a sick person, that actual spike proteins could be seen protruding from the virus (which has not been found), you would find that such evidence doesn't exist.

If you go looking in the published scientific literature for actual pictures, proof, that these spike proteins or any viral proteins are ever attached to any receptor embedded in any cell membrane, you would also find that no such evidence exists. If you were to look for a video or documented evidence of the intact virus injecting its genetic material into the body of the cell, reproducing itself and then emerging victorious by budding off the cell membrane, you would find that no such evidence exists.

The closest thing you would find is electron micrograph pictures of cellular particles, possibly attached to cell debris, both of which to be seen were stained by heavy metals, a process that completely distorts their architecture within the living organism. This is like finding bits of paper stuck to the blown-up bricks, thereby proving the paper emerged by taking pieces of the bricks on its way out.

The Enders baloney

Cowan describes the 'Covid' story as being just as make-believe as his paper story and he charts back this fantasy to a Nobel Prize winner called John Enders (1897-1985), an American biomedical scientist who has been dubbed 'The Father of Modern Vaccines'. Enders is claimed to have 'discovered' the process of the viral culture which 'proved' that a 'virus' caused measles. Cowan explains how Enders did this 'by using the EXACT same procedure that has been followed by every virologist to find and characterize every new virus since 1954'. Enders took throat swabs from children with measles and immersed them in 2ml of milk. Penicillin (100u/ml) and the antibiotic streptomycin (50,g/ml) were added and the whole mix was centrifuged – rotated at high speed to separate large cellular debris from small particles and molecules as with milk and cream, for example. Cowan says that if the aim is to find little particles of genetic material ('viruses') in the snot from children with measles it would seem that the last thing you would do is mix the snot with other material – milk –that also has genetic material. 'How are you ever going to know whether whatever you found came from the snot or the milk?' He points out that streptomycin is a 'nephrotoxic' or poisonous-to-the-kidney drug. You will see the relevance of that

shortly. Cowan says that it gets worse, much worse, when Enders describes the culture medium upon which the virus 'grows': 'The culture medium consisted of bovine amniotic fluid (90%), beef embryo extract (5%), horse serum (5%), antibiotics and phenol red as an indicator of cell metabolism.' Cowan asks incredulously: 'Did he just say that the culture medium also contained fluids and tissues that are themselves rich sources of genetic material?' The genetic cocktail, or 'medium', is inoculated onto tissue and cells from rhesus monkey *kidney* tissue. This is where the importance of streptomycin comes in and currently-used antimicrobials and other drugs that are *poisonous to kidneys* and used in ALL modern viral cultures (e.g. gentamicin, streptomycin, and amphotericin). Cowan asks: 'How are you ever going to know from this witch's brew where any genetic material comes from as we now have five different sources of rich genetic material in our mix?' Remember, he says, that all genetic material, whether from monkey kidney tissues, bovine serum, milk, etc., is made from the exact same components. The same central question returns: 'How are you possibly going to know that it was the virus that killed the kidney tissue and not the toxic antibiotic and starvation rations on which you are growing the tissue?' John Enders answered the question himself – *you can't*:

A second agent was obtained from an uninoculated culture of monkey kidney cells. The cytopathic changes [death of the cells] it induced in the unstained preparations could not be distinguished with confidence from the viruses isolated from measles.

The death of the cells ('cytopathic changes') happened in exactly the same manner, whether they inoculated the kidney tissue with the measles snot or not, Cowan says. 'This is evidence that the destruction of the tissue, the very proof of viral causation of illness, was not caused by anything in the snot because they saw the same destructive effect when the snot was not even used … the cytopathic, i.e., cell-killing, changes come from the process of the culture itself, not from any virus in any snot, period.' Enders quotes in his 1957 paper a virologist called Ruckle as reporting similar findings 'and in addition has isolated an agent from monkey kidney tissue that is so

far indistinguishable from human measles virus'. In other words, Cowan says, these particles called 'measles viruses' are simply and clearly breakdown products of the starved and poisoned tissue. For measles 'virus' see all 'viruses' including the so-called 'Covid virus'. Enders, the 'Father of Modern Vaccines', also said:

There is a potential risk in employing cultures of primate cells for the production of vaccines composed of attenuated virus, since the presence of other agents possibly latent in primate tissues cannot be definitely excluded by any known method.

Cowan further quotes from a paper published in the journal *Viruses* in May, 2020, while the 'Covid pandemic' was well underway in the media if not in reality. 'EVs' here refers to particles of genetic debris from our own tissues, such as exosomes of which more in a moment: 'The remarkable resemblance between EVs and viruses has caused quite a few problems in the studies focused on the analysis of EVs released during viral infections.' Later the paper adds that to date a reliable method that can actually guarantee a complete separation (of EVs from viruses) DOES NOT EXIST. This was published at a time when a fairy tale 'virus' was claimed in total certainty to be causing a fairy tale 'viral disease' called 'Covid-19' – a fairy tale that was already well on the way to transforming human society in the image that the Cult has worked to achieve for so long. Cowan concludes his article:

To summarize, there is no scientific evidence that pathogenic viruses exist. What we think of as 'viruses' are simply the normal breakdown products of dead and dying tissues and cells. When we are well, we make fewer of these particles; when we are starved, poisoned, suffocated by wearing masks, or afraid, we make more.

There is no engineered virus circulating and making people sick. People in laboratories all over the world are making genetically modified products to make people sick. These are called vaccines. There is no virome, no 'ecosystem' of viruses, viruses are not 8%, 50% or 100 % of our genetic material. These are all simply erroneous ideas based on the misconception called a virus.

What is 'Covid'? Load of bollocks

The background described here by Cowan and Lanka was emphasised in the first video presentation that I saw by Dr Andrew Kaufman when he asked whether the 'Covid virus' was in truth a natural defence mechanism of the body called 'exosomes'. These are released by cells when in states of toxicity – see the same themes returning over and over. They are released ever more profusely as chemical and radiation toxicity increases and think of the potential effect therefore of 5G alone as its destructive frequencies infest the human energetic information field with a gathering pace (5G went online in Wuhan in 2019 as the 'virus' emerged). I'll have more about this later. Exosomes transmit a warning to the rest of the body that 'Houston, we have a problem'. Kaufman presented images of exosomes and compared them with 'Covid' under an electron microscope and the similarity was remarkable. They both attach to the same cell receptors (*claimed* in the case of 'Covid'), contain the same genetic material in the form of RNA or ribonucleic acid, and both are found in 'viral cell cultures' with damaged or dying cells. James Hildreth MD, President and Chief Executive Officer of the Meharry Medical College at Johns Hopkins, said: 'The virus is fully an exosome in every sense of the word.' Kaufman's conclusion was that there is no 'virus': 'This entire pandemic is a completely manufactured crisis … there is no evidence of anyone dying from [this] illness.' Dr Tom Cowan and Sally Fallon Morell, authors of *The Contagion Myth*, published a statement with Dr Kaufman in February, 2021, explaining why the 'virus' does not exist and you can read it that in full in the Appendix.

'Virus' theory can be traced to the 'cell theory' in 1858 of German physician Rudolf Virchow (1821-1920) who contended that disease originates from a single cell infiltrated by a 'virus'. Dr Stefan Lanka said that findings and insights with respect to the structure, function and central importance of tissues in the creation of life, which were already known in 1858, comprehensively refute the cell theory. Virchow ignored them. We have seen the part later played by John Enders in the 1950s and Lanka notes that infection theories were only established as a global dogma through the policies and

eugenics of the Third Reich in Nazi Germany (creation of the same Sabbatian cult behind the 'Covid' hoax). Lanka said: 'Before 1933, scientists dared to contradict this theory; after 1933, these critical scientists were silenced'. Dr Tom Cowan's view is that ill-heath is caused by too much of something, too little of something, or toxification from chemicals and radiation – not contagion. We must also highlight as a major source of the 'virus' theology a man still called the 'Father of Modern Virology' – Thomas Milton Rivers (1888-1962). There is no way given the Cult's long game policy that it was a coincidence for the 'Father of Modern Virology' to be director of the Rockefeller Institute for Medical Research from 1937 to 1956 when he is credited with making the Rockefeller Institute a leader in 'viral research'. Cult Rockefellers were the force behind the creation of Big Pharma 'medicine', established the World Health Organisation in 1948, and have long and close associations with the Gates family that now runs the WHO during the pandemic hoax through mega-rich Cult gofer and psychopath Bill Gates.

Only a Renegade Mind can see through all this bullshit by asking the questions that need to be answered, not taking 'no' or prevarication for an answer, and certainly not hiding from the truth in fear of speaking it. Renegade Minds have always changed the world for the better and they will change this one no matter how bleak it may currently appear to be.

CHAPTER SIX

Sequence of deceit

If you tell the truth, you don't have to remember anything
Mark Twain

Against the background that I have laid out this far the sequence that took us from an invented 'virus' in Cult-owned China in late 2019 to the fascist transformation of human society can be seen and understood in a whole new context.

We were told that a deadly disease had broken out in Wuhan and the world media began its campaign (coordinated by behavioural psychologists as we shall see) to terrify the population into unquestioning compliance. We were shown images of Chinese people collapsing in the street which never happened in the West with what was supposed to be the same condition. In the earliest days when alleged cases and deaths were few the fear register was hysterical in many areas of the media and this would expand into the common media narrative across the world. The real story was rather different, but we were never told that. The Chinese government, one of the Cult's biggest centres of global operation, said they had discovered a new illness with flu-like and pneumonia-type symptoms in a city with such toxic air that it is overwhelmed with flu-like symptoms, pneumonia and respiratory disease. Chinese scientists said it was a new – 'novel' – coronavirus which they called Sars-Cov-2 and that it caused a disease they labelled 'Covid-19'. There was no evidence for this and the 'virus' has never to this day been isolated, purified and its genetic code established from that. It

was from the beginning a computer-generated fiction. Stories of Chinese whistleblowers saying the number of deaths was being supressed or that the 'new disease' was related to the Wuhan bio-lab misdirected mainstream and alternative media into cul-de-sacs to obscure the real truth – there was no 'virus'.

Chinese scientists took genetic material from the lung fluid of just a few people and said they had found a 'new' disease when this material had a wide range of content. There was no evidence for a 'virus' for the very reasons explained in the last two chapters. The 'virus' has never been shown to (a) exist and (b) cause any disease. People were diagnosed on symptoms that are so widespread in Wuhan and polluted China and with a PCR test that can't detect infectious disease. On this farce the whole global scam was sold to the rest of the world which would also diagnose respiratory disease as 'Covid-19' from symptoms alone or with a PCR test not testing for a 'virus'. Flu miraculously disappeared *worldwide* in 2020 and into 2021 as it was redesignated 'Covid-19'. It was really the same old flu with its 'flu-like' symptoms attributed to 'flu-like' 'Covid-19'. At the same time with very few exceptions the Chinese response of draconian lockdown and fascism was the chosen weapon to respond across the West as recommended by the Cult-owned Tedros at the Cult-owned World Health Organization run by the Cult-owned Gates. All was going according to plan. Chinese scientists – everything in China is controlled by the Cult-owned government – compared their contaminated RNA lung-fluid material with other RNA sequences and said it appeared to be just under 80 percent identical to the SARS-CoV-1 'virus' claimed to be the cause of the SARS (severe acute respiratory syndrome) 'outbreak' in 2003. They decreed that because of this the 'new virus' had to be related and they called it SARS-CoV-2. There are some serious problems with this assumption and *assumption* was all it was. Most 'factual' science turns out to be assumptions repeated into everyone-knows-that. A match of under 80-percent is meaningless. Dr Kaufman makes the point that there's a *96 percent* genetic correlation between humans and chimpanzees, but 'no one would say our genetic material is part

of the chimpanzee family'. Yet the Chinese authorities were claiming that a much lower percentage, less than 80 percent, proved the existence of a new 'coronavirus'. For goodness sake human DNA is 60 percent similar to a *banana*.

You are feeling sleepy

The entire 'Covid' hoax is a global Psyop, a psychological operation to program the human mind into believing and fearing a complete fantasy. A crucial aspect of this was what *appeared* to happen in Italy. It was all very well streaming out daily images of an alleged catastrophe in Wuhan, but to the Western mind it was still on the other side of the world in a very different culture and setting. A reaction of 'this could happen to me and my family' was still nothing like as intense enough for the mind-doctors. The Cult needed a Western example to push people over that edge and it chose Italy, one of its major global locations going back to the Roman Empire. An Italian 'Covid' crisis was manufactured in a particular area called Lombardy which just happens to be notorious for its toxic air and therefore respiratory disease. Wuhan, China, déjà vu. An hysterical media told horror stories of Italians dying from 'Covid' in their droves and how Lombardy hospitals were being overrun by a tidal wave of desperately ill people needing treatment after being struck down by the 'deadly virus'. Here was the psychological turning point the Cult had planned. Wow, if this is happening in Italy, the Western mind concluded, this indeed could happen to me and my family. Another point is that Italian authorities responded by following the Chinese blueprint so vehemently recommended by the Cult-owned World Health Organization. They imposed fascistic lockdowns on the whole country viciously policed with the help of surveillance drones sweeping through the streets seeking out anyone who escaped from mass house arrest. Livelihoods were destroyed and psychology unravelled in the way we have witnessed since in all lockdown countries. Crucial to the plan was that Italy responded in this way to set the precedent of suspending freedom and imposing fascism in a 'Western liberal democracy'. I emphasised in an

animated video explanation on davidicke.com posted in the summer of 2020 how important it was to the Cult to expand the Chinese lockdown model across the West. Without this, and the bare-faced lie that non-symptomatic people could still transmit a 'disease' they didn't have, there was no way locking down the whole population, sick and not sick, could be pulled off. At just the right time and with no evidence Cult operatives and gofers claimed that people without symptoms could pass on the 'disease'. In the name of protecting the 'vulnerable' like elderly people, who lockdowns would kill by the tens of thousands, we had for the first time healthy people told to isolate as well as the sick. The great majority of people who tested positive had no symptoms because there was nothing wrong with them. It was just a trick made possible by a test not testing for the 'virus'.

Months after my animated video the Gates-funded Professor Neil Ferguson at the Gates-funded Imperial College confirmed that I was right. He didn't say it in those terms, naturally, but he did say it. Ferguson will enter the story shortly for his outrageously crazy 'computer models' that led to Britain, the United States and many other countries following the Chinese and now Italian methods of response. Put another way, following the Cult script. Ferguson said that SAGE, the UK government's scientific advisory group which has controlled 'Covid' policy from the start, wanted to follow the Chinese lockdown model (while they all continued to work and be paid), but they wondered if they could possibly, in Ferguson's words, 'get away with it in Europe'. 'Get away with it'? Who the hell do these moronic, arrogant people think they are? This appalling man Ferguson said that once Italy went into national lockdown they realised they, too, could mimic China:

> It's a communist one-party state, we said. We couldn't get away with it in Europe, we thought … and then Italy did it. And we realised we could. Behind this garbage from Ferguson is a simple fact: Doing the same as China in every country was the plan from the start and Ferguson's 'models' would play a central role in achieving that. It's just a coincidence, of course, and absolutely nothing to worry your little head about.

Oops, sorry, our mistake

Once the Italian segment of the Psyop had done the job it was designed to do a very different story emerged. Italian authorities revealed that 99 percent of those who had 'died from Covid-19' in Italy had one, two, three, or more 'co-morbidities' or illnesses and health problems that could have ended their life. The US Centers for Disease Control and Prevention (CDC) published a figure of 94 percent for Americans dying of 'Covid' while having other serious medical conditions – on average two to three (some five or six) other potential causes of death. In terms of death from an unproven 'virus' I say it is 100 percent. The other one percent in Italy and six percent in the US would presumably have died from 'Covid's' flu-like symptoms with a range of other possible causes in conjunction with a test not testing for the 'virus'. Fox News reported that even more startling figures had emerged in one US county in which 410 of 422 deaths attributed to 'Covid-19' had other potentially deadly health conditions. The Italian National Health Institute said later that the average age of people dying with a 'Covid-19' diagnosis in Italy was about 81. Ninety percent were over 70 with ten percent over 90. In terms of other reasons to die some 80 percent had two or more chronic diseases with half having three or more including cardiovascular problems, diabetes, respiratory problems and cancer. Why is the phantom 'Covid-19' said to kill overwhelmingly old people and hardly affect the young? Old people continually die of many causes and especially respiratory disease which you can re-diagnose 'Covid-19' while young people die in tiny numbers by comparison and rarely of respiratory disease. Old people 'die of Covid' because they die of other things that can be redesignated 'Covid' and it really is that simple.

Flu has flown

The blueprint was in place. Get your illusory 'cases' from a test not testing for the 'virus' and redesignate other causes of death as 'Covid-19'. You have an instant 'pandemic' from something that is nothing more than a computer-generated fiction. With near-on a

billion people having 'flu-like' symptoms every year the potential was limitless and we can see why flu quickly and apparently miraculously disappeared *worldwide* by being diagnosed 'Covid-19'. The painfully bloody obvious was explained away by the childlike media in headlines like this in the UK '*Independent*': 'Not a single case of flu detected by Public Health England this year as Covid restrictions suppress virus'. I kid you not. The masking, social distancing and house arrest that did not make the 'Covid virus' disappear somehow did so with the 'flu virus'. Even worse the article, by a bloke called Samuel Lovett, suggested that maybe the masking, sanitising and other 'Covid' measures should continue to keep the flu away. With a ridiculousness that disturbs your breathing (it's 'Covid-19') the said Lovett wrote: 'With widespread social distancing and mask-wearing measures in place throughout the UK, the usual routes of transmission for influenza have been blocked.' He had absolutely no evidence to support that statement, but look at the consequences of him acknowledging the obvious. With flu not disappearing at all and only being relabelled 'Covid-19' he would have to contemplate that 'Covid' was a hoax on a scale that is hard to imagine. You need guts and commitment to truth to even go there and that's clearly something Samuel Lovett does not have in abundance. He would never have got it through the editors anyway.

Tens of thousands die in the United States alone every winter from flu including many with pneumonia complications. CDC figures record *45 million* Americans diagnosed with flu in 2017-2018 of which 61,000 died and some reports claim 80,000. Where was the same hysteria then that we have seen with 'Covid-19'? Some 250,000 Americans are admitted to hospital with pneumonia every year with about 50,000 cases proving fatal. About 65 million suffer respiratory disease every year and three million deaths makes this the third biggest cause of death worldwide. You only have to redesignate a portion of all these people 'Covid-19' and you have an instant global pandemic or the *appearance* of one. Why would doctors do this? They are told to do this and all but a few dare not refuse those who must be obeyed. Doctors in general are not researching their own

knowledge and instead take it direct and unquestioned from the authorities that own them and their careers. The authorities say they must now diagnose these symptoms 'Covid-19' and not flu, or whatever, and they do it. Dark suits say put 'Covid-19' on death certificates no matter what the cause of death and the doctors do it. Renegade Minds don't fall for the illusion that doctors and medical staff are all highly-intelligent, highly-principled, seekers of medical truth. *Some are*, but not the majority. They are repeaters, gofers, and yes sir, no sir, purveyors of what the system demands they purvey. The 'Covid' con is not merely confined to diseases of the lungs. Instructions to doctors to put 'Covid-19' on death certificates for anyone dying of *anything* within 28 days (or much more) of a positive test not testing for the 'virus' opened the floodgates. The term dying *with* 'Covid' and not *of* 'Covid' was coined to cover the truth. Whether it was a *with* or an *of* they were all added to the death numbers attributed to the 'deadly virus' compiled by national governments and globally by the Gates-funded Johns Hopkins operation in the United States that was so involved in those 'pandemic' simulations. Fraudulent deaths were added to the ever-growing list of fraudulent 'cases' from false positives from a false test. No wonder Professor Walter Ricciardi, scientific advisor to the Italian minister of health, said after the Lombardy hysteria had done its job that 'Covid' death rates were due to Italy having the second oldest population in the world and to *how hospitals record deaths*:

The way in which we code deaths in our country is very generous in the sense that all the people who die in hospitals with the coronavirus are deemed to be dying of the coronavirus. On re-evaluation by the National Institute of Health, only 12 per cent of death certificates have shown a direct causality from coronavirus, while 88 per cent of patients who have died have at least one pre-morbidity – many had two or three.

This is extraordinary enough when you consider the propaganda campaign to use Italy to terrify the world, but how can they even say twelve percent were genuine when the 'virus' has not been shown to exist, its 'code' is a computer program, and diagnosis comes from a test not testing for it? As in China, and soon the world, 'Covid-19' in

Italy was a redesignation of diagnosis. Lies and corruption were to become the real 'pandemic' fuelled by a pathetically-compliant medical system taking its orders from the tiny few at the top of their national hierarchy who answered to the World Health Organization which answers to Gates and the Cult. Doctors were told – ordered – to diagnose a particular set of symptoms 'Covid-19' and put that on the death certificate for any cause of death if the patient had tested positive with a test not testing for the virus or had 'Covid' symptoms like the flu. The United States even introduced big financial incentives to manipulate the figures with hospitals receiving £4,600 from the Medicare system for diagnosing someone with regular pneumonia, $13,000 if they made the diagnosis from the same symptoms 'Covid-19' pneumonia, and $39, 000 if they put a 'Covid' diagnosed patient on a ventilator that would almost certainly kill them. A few – painfully and pathetically few – medical whistleblowers revealed (before Cult-owned YouTube deleted their videos) that they had been instructed to 'let the patient crash' and put them straight on a ventilator instead of going through a series of far less intrusive and dangerous methods as they would have done before the pandemic hoax began and the financial incentives kicked in. We are talking cold-blooded murder given that ventilators are so damaging to respiratory systems they are usually the last step before heaven awaits. Renegade Minds never fall for the belief that people in white coats are all angels of mercy and cannot be full-on psychopaths. I have explained in detail in *The Answer* how what I am describing here played out across the world coordinated by the World Health Organization through the medical hierarchies in almost every country.

Medical scientist calls it

Information about the non-existence of the 'virus' began to emerge for me in late March, 2020, and mushroomed after that. I was sent an email by Sir Julian Rose, a writer, researcher, and organic farming promotor, from a medical scientist friend of his in the United States. Even at that early stage in March the scientist was able to explain

how the 'Covid' hoax was being manipulated. He said there were no reliable tests for a specific 'Covid-19 virus' and nor were there any reliable agencies or media outlets for reporting numbers of actual 'Covid-19' cases. We have seen in the long period since then that he was absolutely right. 'Every action and reaction to Covid-19 is based on totally flawed data and we simply cannot make accurate assessments,' he said. Most people diagnosed with 'Covid-19' were showing nothing more than cold and flu-like symptoms 'because most coronavirus strains *are* nothing more than cold/flu-like symptoms'. We had farcical situations like an 84-year-old German man testing positive for 'Covid-19' and his nursing home ordered to quarantine only for him to be found to have a common cold. The scientist described back then why PCR tests and what he called the 'Mickey Mouse test kits' were useless for what they were claimed to be identifying. 'The idea these kits can isolate a specific virus like Covid-19 is nonsense,' he said. Significantly, he pointed out that 'if you want to create a totally false panic about a totally false pandemic – pick a coronavirus'. This is exactly what the Cult-owned Gates, World Economic Forum and Johns Hopkins University did with their Event 201 'simulation' followed by their real-life simulation called the 'pandemic'. The scientist said that all you had to do was select the sickest of people with respiratory-type diseases in a single location – 'say Wuhan' – and administer PCR tests to them. You can then claim that anyone showing 'viral sequences' similar to a coronavirus 'which will inevitably be quite a few' is suffering from a 'new' disease:

> Since you already selected the sickest flu cases a fairly high proportion of your sample will go on to die. You can then say this 'new' virus has a CFR [case fatality rate] higher than the flu and use this to infuse more concern and do more tests which will of course produce more 'cases', which expands the testing, which produces yet more 'cases' and so on and so on. Before long you have your 'pandemic', and all you have done is use a simple test kit trick to convert the worst flu and pneumonia cases into something new that doesn't ACTUALLY EXIST [my emphasis].

He said that you then 'just run the same scam in other countries' and make sure to keep the fear message running high 'so that people

will feel panicky and less able to think critically'. The only problem to overcome was the fact *there is no* actual new deadly pathogen and only regular sick people. This meant that deaths from the 'new deadly pathogen' were going to be way too low for a real new deadly virus pandemic, but he said this could be overcome in the following ways – all of which would go on to happen:

1. You can claim this is just the beginning and more deaths are imminent [you underpin this with fantasy 'computer projections']. Use this as an excuse to quarantine everyone and then claim the quarantine prevented the expected millions of dead.

2. You can [say that people] 'minimizing' the dangers are irresponsible and bully them into not talking about numbers.

3. You can talk crap about made up numbers hoping to blind people with pseudoscience.

4. You can start testing well people (who, of course, will also likely have shreds of coronavirus [RNA] in them) and thus inflate your 'case figures' with 'asymptomatic carriers' (you will of course have to spin that to sound deadly even though any virologist knows the more symptom-less cases you have the less deadly is your pathogen).

The scientist said that if you take these simple steps 'you can have your own entirely manufactured pandemic up and running in weeks'. His analysis made so early in the hoax was brilliantly prophetic of what would actually unfold. Pulling all the information together in these recent chapters we have this is simple 1, 2, 3, of how you can delude virtually the entire human population into believing in a 'virus' that doesn't exist:

- A 'Covid case' is someone who tests positive with a test not testing for the 'virus'.

- A 'Covid death' is someone who dies of *any cause* within 28 days (or much longer) of testing positive with a test not testing for the 'virus.

- Asymptomatic means there is nothing wrong with you, but they claim you can pass on what you don't have to justify locking

down (quarantining) healthy people in totality.

The foundations of the hoax are that simple. A study involving ten million people in Wuhan, published in November, 2020, demolished the whole lie about those without symptoms passing on the 'virus'. They found '300 asymptomatic cases' and traced their contacts to find that not one of them was detected with the 'virus'. 'Asymptomatic' patients and their contacts were isolated for no less than two weeks and nothing changed. I know it's all crap, but if you are going to claim that those without symptoms can transmit 'the virus' then you must produce evidence for that and they never have. Even World Health Organization official Dr Maria Van Kerkhove, head of the emerging diseases and zoonosis unit, said as early as June, 2020, that she doubted the validity of asymptomatic transmission. She said that 'from the data we have, it still seems to be rare that an asymptomatic person actually transmits onward to a secondary individual' and by 'rare' she meant that she couldn't cite any case of asymptomatic transmission.

The Ferguson factor

The problem for the Cult as it headed into March, 2020, when the script had lockdown due to start, was that despite all the manipulation of the case and death figures they still did not have enough people alleged to have died from 'Covid' to justify mass house arrest. This was overcome in the way the scientist described: 'You can claim this is just the beginning and more deaths are imminent … Use this as an excuse to quarantine everyone and then claim the quarantine prevented the expected millions of dead.' Enter one Professor Neil Ferguson, the Gates-funded 'epidemiologist' at the Gates-funded Imperial College in London. Ferguson is Britain's Christian Drosten in that he has a dire record of predicting health outcomes, but is still called upon to advise government on the next health outcome when another 'crisis' comes along. This may seem to be a strange and ridiculous thing to do. Why would you keep turning for policy guidance to people who have a history of being

monumentally wrong? Ah, but it makes sense from the Cult point of view. These 'experts' keep on producing predictions that suit the Cult agenda for societal transformation and so it was with Neil Ferguson as he revealed his horrific (and clearly insane) computer model predictions that allowed lockdowns to be imposed in Britain, the United States and many other countries. Ferguson does not have even an A-level in biology and would appear to have no formal training in computer modelling, medicine or epidemiology, according to Derek Winton, an MSc in Computational Intelligence. He wrote an article somewhat aghast at what Ferguson did which included taking no account of respiratory disease 'seasonality' which means it is far worse in the winter months. Who would have thought that respiratory disease could be worse in the winter? Well, certainly not Ferguson.

The massively China-connected Imperial College and its bizarre professor provided the excuse for the long-incubated Chinese model of human control to travel westward at lightning speed. Imperial College confirms on its website that it collaborates with the Chinese Research Institute; publishes more than 600 research papers every year with Chinese research institutions; has 225 Chinese staff; 2,600 Chinese students – the biggest international group; 7,000 former students living in China which is the largest group outside the UK; and was selected for a tour by China's President Xi Jinping during his state visit to the UK in 2015. The college takes major donations from China and describes itself as the UK's number one university collaborator with Chinese research institutions. The China communist/fascist government did not appear phased by the woeful predictions of Ferguson and Imperial when during the lockdown that Ferguson induced the college signed a five-year collaboration deal with China tech giant Huawei that will have Huawei's indoor 5G network equipment installed at the college's West London tech campus along with an 'AI cloud platform'. The deal includes Chinese sponsorship of Imperial's Venture Catalyst entrepreneurship competition. Imperial is an example of the enormous influence the Chinese government has within British and North American

universities and research centres – and further afield. Up to 200 academics from more than a dozen UK universities are being investigated on suspicion of 'unintentionally' helping the Chinese government build weapons of mass destruction by 'transferring world-leading research in advanced military technology such as aircraft, missile designs and cyberweapons'. Similar scandals have broken in the United States, but it's all a coincidence. Imperial College serves the agenda in many other ways including the promotion of every aspect of the United Nations Agenda 21/2030 (the Great Reset) and produced computer models to show that human-caused 'climate change' is happening when in the real world it isn't. Imperial College is driving the climate agenda as it drives the 'Covid' agenda (both Cult hoaxes) while Patrick Vallance, the UK government's Chief Scientific Adviser on 'Covid', was named Chief Scientific Adviser to the UN 'climate change' conference known as COP26 hosted by the government in Glasgow, Scotland. 'Covid' and 'climate' are fundamentally connected.

Professor Woeful

From Imperial's bosom came Neil Ferguson still advising government despite his previous disasters and it was announced early on that he and other key people like UK Chief Medical Adviser Chris Whitty had caught the 'virus' as the propaganda story was being sold. Somehow they managed to survive and we had Prime Minister Boris Johnson admitted to hospital with what was said to be a severe version of the 'virus' in this same period. His whole policy and demeanour changed when he returned to Downing Street. It's a small world with these government advisors – especially in their communal connections to Gates – and Ferguson had partnered with Whitty to write a paper called 'Infectious disease: Tough choices to reduce Ebola transmission' which involved another scare-story that didn't happen. Ferguson's 'models' predicted that up to150, 000 could die from 'mad cow disease', or BSE, and its version in sheep if it was transmitted to humans. BSE was not transmitted and instead triggered by an organophosphate pesticide used to treat a pest on

cows. Fewer than 200 deaths followed from the human form. Models by Ferguson and his fellow incompetents led to the unnecessary culling of millions of pigs, cattle and sheep in the foot and mouth outbreak in 2001 which destroyed the lives and livelihoods of farmers and their families who had often spent decades building their herds and flocks. Vast numbers of these animals did not have foot and mouth and had no contact with the infection. Another 'expert' behind the cull was Professor Roy Anderson, a computer modeller at Imperial College specialising in the epidemiology of *human*, not animal, disease. Anderson has served on the Bill and Melinda Gates Grand Challenges in Global Health advisory board and chairs another Gates-funded organisation. Gates is everywhere.

In a precursor to the 'Covid' script Ferguson backed closing schools 'for prolonged periods' over the swine flu 'pandemic' in 2009 and said it would affect a third of the world population if it continued to spread at the speed he claimed to be happening. His mates at Imperial College said much the same and a news report said: 'One of the authors, the epidemiologist and disease modeller Neil Ferguson, who sits on the World Health Organisation's emergency committee for the outbreak, said the virus had "full pandemic potential".' Professor Liam Donaldson, the Chris Whitty of his day as Chief Medical Officer, said the worst case could see 30 percent of the British people infected by swine flu with 65,000 dying. Ferguson and Donaldson were indeed proved correct when at the end of the year the number of deaths attributed to swine flu was 392. The term 'expert' is rather liberally applied unfortunately, not least to complete idiots. Swine flu 'projections' were great for GlaxoSmithKline (GSK) as millions rolled in for its Pandemrix influenza vaccine which led to brain damage with children most affected. The British government (taxpayers) paid out more than £60 million in compensation after GSK was given immunity from prosecution. Yet another 'Covid' déjà vu. Swine flu was supposed to have broken out in Mexico, but Dr Wolfgang Wodarg, a German doctor, former member of parliament and critic of the 'Covid' hoax, observed 'the spread of swine flu' in Mexico City at the time. He

said: 'What we experienced in Mexico City was a very mild flu which did not kill more than usual – which killed even fewer people than usual.' Hyping the fear against all the facts is not unique to 'Covid' and has happened many times before. Ferguson is reported to have over-estimated the projected death toll of bird flu (H5N1) by some three million-fold, but bird flu vaccine makers again made a killing from the scare. This is some of the background to the Neil Ferguson who produced the perfectly-timed computer models in early 2020 predicting that half a million people would die in Britain without draconian lockdown and 2.2 million in the United States. Politicians panicked, people panicked, and lockdowns of alleged short duration were instigated to 'flatten the curve' of cases gleaned from a test not testing for the 'virus'. I said at the time that the public could forget the 'short duration' bit. This was an agenda to destroy the livelihoods of the population and force them into mass control through dependency and there was going to be nothing 'short' about it. American researcher Daniel Horowitz described the consequences of the 'models' spewed out by Gates-funded Ferguson and Imperial College:

> What led our government and the governments of many other countries into panic was a single Imperial College of UK study, funded by global warming activists, that predicted 2.2 million deaths if we didn't lock down the country. In addition, the reported 8-9% death rate in Italy scared us into thinking there was some other mutation of this virus that they got, which might have come here.
>
> Together with the fact that we were finally testing and had the ability to actually report new cases, we thought we were headed for a death spiral. But again … we can't flatten a curve if we don't know when the curve started.

How about it *never* started?

Giving them what they want

An investigation by German news outlet *Welt Am Sonntag (World on Sunday)* revealed how in March, 2020, the German government gathered together 'leading scientists from several research institutes and universities' and 'together, they were to produce a [modelling]

paper that would serve as legitimization for further tough political measures'. The Cult agenda was justified by computer modelling not based on evidence or reality; it was specifically constructed to justify the Cult demand for lockdowns all over the world to destroy the independent livelihoods of the global population. All these modellers and everyone responsible for the 'Covid' hoax have a date with a trial like those in Nuremberg after World War Two when Nazis faced the consequences of their war crimes. These corrupt-beyond-belief 'modellers' wrote the paper according to government instructions and it said that that if lockdown measures were lifted then up to one million Germans would die from 'Covid-19' adding that some would die 'agonizingly at home, gasping for breath' unable to be treated by hospitals that couldn't cope. All lies. No matter – it gave the Cult all that it wanted. What did long-time government 'modeller' Neil Ferguson say? If the UK and the United States didn't lockdown half a million would die in Britain and 2.2 million Americans. Anyone see a theme here? 'Modellers' are such a crucial part of the lockdown strategy that we should look into their background and follow the money. Researcher Rosemary Frei produced an excellent article headlined 'The Modelling-paper Mafiosi'. She highlights a guy called John Edmunds, a British epidemiologist, and professor in the Faculty of Epidemiology and Population Health at the London School of Hygiene & Tropical Medicine. He studied at Imperial College. Edmunds is a member of government 'Covid' advisory bodies which have been dictating policy, the New and Emerging Respiratory Virus Threats Advisory Group (NERVTAG) and the Scientific Advisory Group for Emergencies (SAGE).

Ferguson, another member of NERVTAG and SAGE, led the way with the original 'virus' and Edmunds has followed in the 'variant' stage and especially the so-called UK or Kent variant known as the 'Variant of Concern' (VOC) B.1.1.7. He said in a co-written report for the Centre for Mathematical modelling of Infectious Diseases at the London School of Hygiene and Tropical Medicine, with input from the Centre's 'Covid-19' Working Group, that there was 'a realistic

possibility that VOC B.1.1.7 is associated with an increased risk of death compared to non-VOC viruses'. Fear, fear, fear, get the vaccine, fear, fear, fear, get the vaccine. Rosemary Frei reveals that almost all the paper's authors and members of the modelling centre's 'Covid-19' Working Group receive funding from the Bill and Melinda Gates Foundation and/or the associated Gates-funded Wellcome Trust. The paper was published by e-journal *Medr χiv* which only publishes papers not peer-reviewed and the journal was established by an organisation headed by Facebook's Mark Zuckerberg and his missus. What a small world it is. Frei discovered that Edmunds is on the Scientific Advisory Board of the Coalition for Epidemic Preparedness Innovations (CEPI) which was established by the Bill and Melinda Gates Foundation, Klaus Schwab's Davos World Economic Forum and Big Pharma giant Wellcome. CEPI was 'launched in Davos [in 2017] to develop vaccines to stop future epidemics', according to its website. 'Our mission is to accelerate the development of vaccines against emerging infectious diseases and enable equitable access to these vaccines for people during outbreaks.' What kind people they are. Rosemary Frei reveals that Public Health England (PHE) director Susan Hopkins is an author of her organisation's non-peer-reviewed reports on 'new variants'. Hopkins is a professor of infectious diseases at London's Imperial College which is gifted tens of millions of dollars a year by the Bill and Melinda Gates Foundation. Gates-funded modelling disaster Neil Ferguson also co-authors Public Health England reports and he spoke in December, 2020, about the potential danger of the B.1.1.7. 'UK variant' promoted by Gates-funded modeller John Edmunds. When I come to the 'Covid vaccines' the 'new variants' will be shown for what they are – bollocks.

Connections, connections

All these people and modellers are lockdown-obsessed or, put another way, they demand what the Cult demands. Edmunds said in January, 2021, that to ease lockdowns too soon would be a disaster and they had to 'vaccinate much, much, much more widely than the

elderly'. Rosemary Frei highlights that Edmunds is married to Jeanne Pimenta who is described in a LinkedIn profile as director of epidemiology at GlaxoSmithKline (GSK) and she held shares in the company. Patrick Vallance, co-chair of SAGE and the government's Chief Scientific Adviser, is a former executive of GSK and has a deferred bonus of shares in the company worth £600,000. GSK has serious business connections with Bill Gates and is collaborating with mRNA-'vaccine' company CureVac to make 'vaccines' for the new variants that Edmunds is talking about. GSK is planning a 'Covid vaccine' with drug giant Sanofi. Puppet Prime Minister Boris Johnson announced in the spring of 2021 that up to 60 million vaccine doses were to be made at the GSK facility at Barnard Castle in the English North East. Barnard Castle, with a population of just 6,000, was famously visited in breach of lockdown rules in April, 2020, by Johnson aide Dominic Cummings who said that he drove there 'to test his eyesight' before driving back to London. Cummings would be better advised to test his integrity – not that it would take long. The GSK facility had nothing to do with his visit then although I'm sure Patrick Vallance would have been happy to arrange an introduction and some tea and biscuits. Ruthless psychopath Gates has made yet another fortune from vaccines in collaboration with Big Pharma companies and gushes at the phenomenal profits to be made from vaccines – more than a 20-to-1 return as he told one interviewer. Gates also tweeted in December, 2019, with the foreknowledge of what was coming: 'What's next for our foundation? I'm particularly excited about what the next year could mean for one of the best buys in global health: vaccines.'

Modeller John Edmunds is a big promotor of vaccines as all these people appear to be. He's the dean of the London School of Hygiene & Tropical Medicine's Faculty of Epidemiology and Population Health which is primarily funded by the Bill and Melinda Gates Foundation and the Gates-established and funded GAVI vaccine alliance which is the Gates vehicle to vaccinate the world. The organisation Doctors Without Borders has described GAVI as being 'aimed more at supporting drug-industry desires to promote new

products than at finding the most efficient and sustainable means for fighting the diseases of poverty'. But then that's why the psychopath Gates created it. John Edmunds said in a video that the London School of Hygiene & Tropical Medicine is involved in every aspect of vaccine development including large-scale clinical trials. He contends that mathematical modelling can show that vaccines protect individuals and society. That's on the basis of shit in and shit out, I take it. Edmunds serves on the UK Vaccine Network as does Ferguson and the government's foremost 'Covid' adviser, the grim-faced, dark-eyed Chris Whitty. The Vaccine Network says it works 'to support the government to identify and shortlist targeted investment opportunities for the most promising vaccines and vaccine technologies that will help combat infectious diseases with epidemic potential, and to address structural issues related to the UK's broader vaccine infrastructure'. Ferguson is acting Director of the Imperial College Vaccine Impact Modelling Consortium which has funding from the Bill and Melina Gates Foundation and the Gates-created GAVI 'vaccine alliance'. Anyone wonder why these characters see vaccines as the answer to every problem? Ferguson is wildly enthusiastic in his support for GAVI's campaign to vaccine children en masse in poor countries. You would expect someone like Gates who has constantly talked about the need to reduce the population to want to fund vaccines to keep more people alive. I'm sure that's why he does it. The John Edmunds London School of Hygiene & Tropical Medicine (LSHTM) has a Vaccines Manufacturing Innovation Centre which develops, tests and commercialises vaccines. Rosemary Frei writes:

> The vaccines centre also performs affiliated activities like combating 'vaccine hesitancy'. The latter includes the Vaccine Confidence Project. The project's stated purpose is, among other things, 'to provide analysis and guidance for early response and engagement with the public to ensure sustained confidence in vaccines and immunisation'. The Vaccine Confidence Project's director is LSHTM professor Heidi Larson. For more than a decade she's been researching how to combat vaccine hesitancy.

How the bloody hell can blokes like John Edmunds and Neil Ferguson with those connections and financial ties model 'virus' case

and death projections for the government and especially in a way that gives their paymasters like Gates exactly what they want? It's insane, but this is what you find throughout the world.

'Covid' is not dangerous, oops, wait, yes it is

Only days before Ferguson's nightmare scenario made Jackboot Johnson take Britain into a China-style lockdown to save us from a deadly 'virus' the UK government website gov.uk was reporting something very different to Ferguson on a page of official government guidance for 'high consequence infectious diseases (HCID)'. It said this about 'Covid-19':

As of 19 March 2020, COVID-19 *is no longer considered to be a high consequence infectious diseases (HCID) in the UK* [my emphasis]. The 4 nations public health HCID group made an interim recommendation in January 2020 to classify COVID-19 as an HCID. This was based on consideration of the UK HCID criteria about the virus and the disease with information available during the early stages of the outbreak.

Now that more is known about COVID-19, the public health bodies in the UK have reviewed the most up to date information about COVID-19 against the UK HCID criteria. They have determined that several features have now changed; in particular, more information is available about mortality rates (low overall), and there is now greater clinical awareness and a specific and sensitive laboratory test, the availability of which continues to increase. The Advisory Committee on Dangerous Pathogens (ACDP) is also of the opinion that COVID-19 should no longer be classified as an HCID.

Soon after the government had been exposed for downgrading the risk they upgraded it again and everyone was back to singing from the same Cult hymn book. Ferguson and his fellow Gates clones indicated that lockdowns and restrictions would have to continue until a Gates-funded vaccine was developed. Gates said the same because Ferguson and his like were repeating the Gates script which is the Cult script. 'Flatten the curve' became an ongoing nightmare of continuing lockdowns with periods in between of severe restrictions in pursuit of destroying independent incomes and had nothing to do with protecting health about which the Cult gives not a shit. Why wouldn't Ferguson be pushing a vaccine 'solution' when he's owned by vaccine-obsessive Gates who makes a fortune from them and

when Ferguson heads the Vaccine Impact Modelling Consortium at Imperial College funded by the Gates Foundation and GAVI, the 'vaccine alliance', created by Gates as his personal vaccine promotion operation? To compound the human catastrophe that Ferguson's 'models' did so much to create he was later exposed for breaking his own lockdown rules by having sexual liaisons with his married girlfriend Antonia Staats at his home while she was living at another location with her husband and children. Staats was a 'climate' activist and senior campaigner at the Soros-funded Avaaz which I wouldn't trust to tell me that grass is green. Ferguson had to resign as a government advisor over this hypocrisy in May, 2020, but after a period of quiet he was back being quoted by the ridiculous media on the need for more lockdowns and a vaccine rollout. Other government-advising 'scientists' from Imperial College' held the fort in his absence and said lockdown could be indefinite until a vaccine was found. The Cult script was being sung by the payrolled choir. I said there was no intention of going back to 'normal' when the 'vaccine' came because the 'vaccine' is part of a very different agenda that I will discuss in Human 2.0. Why would the Cult want to let the world go back to normal when destroying that normal forever was the whole point of what was happening? House arrest, closing businesses and schools through lockdown, (un)social distancing and masks all followed the Ferguson fantasy models. Again as I predicted (these people are so predictable) when the 'vaccine' arrived we were told that house arrest, lockdown, (un)social distancing and masks would still have to continue. I will deal with the masks in the next chapter because they are of fundamental importance.

Where's the 'pandemic'?

Any mildly in-depth assessment of the figures revealed what was really going on. Cult-funded and controlled organisations still have genuine people working within them such is the number involved. So it is with Genevieve Briand, assistant program director of the Applied Economics master's degree program at Johns Hopkins

University. She analysed the impact that 'Covid-19' had on deaths from *all* causes in the United States using official data from the CDC for the period from early February to early September, 2020. She found that allegedly 'Covid' *related*-deaths exceeded those from heart disease which she found strange with heart disease always the biggest cause of fatalities. Her research became even more significant when she noted the sudden decline in 2020 of *all* non-'Covid' deaths: 'This trend is completely contrary to the pattern observed in all previous years … the total decrease in deaths by other causes almost exactly equals the increase in deaths by Covid-19.' This was such a game, set and match in terms of what was happening that Johns Hopkins University deleted the article on the grounds that it 'was being used to support false and dangerous inaccuracies about the impact of the pandemic'. No – because it exposed the scam from official CDC figures and this was confirmed when those figures were published in January, 2021. Here we can see the effect of people dying from heart attacks, cancer, road accidents and gunshot wounds – *anything* – having 'Covid-19' on the death certificate along with those diagnosed from 'symptoms' who had even not tested positive with a test not testing for the 'virus'. I am not kidding with the gunshot wounds, by the way. Brenda Bock, coroner in Grand County, Colorado, revealed that two gunshot victims tested positive for the 'virus' within the previous 30 days and were therefore classified as 'Covid deaths'. Bock said: 'These two people had tested positive for Covid, but that's not what killed them. A gunshot wound is what killed them.' She said she had not even finished her investigation when the state listed the gunshot victims as deaths due to the 'virus'. The death and case figures for 'Covid-19' are an absolute joke and yet they are repeated like parrots by the media, politicians and alleged medical 'experts'. The official Cult narrative is the only show in town.

Genevieve Briand found that deaths from all causes were not exceptional in 2020 compared with previous years and a Spanish magazine published figures that said the same about Spain which was a 'Covid' propaganda hotspot at one point. *Discovery Salud*, a

health and medicine magazine, quoted government figures which showed how 17,000 *fewer* people died in Spain in 2020 than in 2019 and more than 26,000 fewer than in 2018. The age-standardised mortality rate for England and Wales when age distribution is taken into account was significantly lower in 2020 than the 1970s, 80s and 90s, and was only the ninth highest since 2000. Where is the 'pandemic'?

Post mortems and autopsies virtually disappeared for 'Covid' deaths amid claims that 'virus-infected' bodily fluids posed a risk to those carrying out the autopsy. This was rejected by renowned German pathologist and forensic doctor Klaus Püschel who said that he and his staff had by then done 150 autopsies on 'Covid' patients with no problems at all. He said they were needed to know why some 'Covid' patients suffered blood clots and not severe respiratory infections. The 'virus' is, after all, called SARS or 'severe acute respiratory syndrome'. I highlighted in the spring of 2020 this phenomenon and quoted New York intensive care doctor Cameron Kyle-Sidell who posted a soon deleted YouTube video to say that they had been told to prepare to treat an infectious disease called 'Covid-19', but that was not what they were dealing with. Instead he likened the lung condition of the most severely ill patients to what you would expect with cabin depressurisation in a plane at 30,000 feet or someone dropped on the top of Everest without oxygen or acclimatisation. I have never said this is not happening to a small minority of alleged 'Covid' patients – I am saying this is not caused by a phantom 'contagious virus'. Indeed Kyle-Sidell said that 'Covid-19' was not the disease they were told was coming their way. 'We are operating under a medical paradigm that is untrue,' he said, and he believed they were treating the wrong disease: 'These people are being slowly starved of oxygen.' Patients would take off their oxygen masks in a state of fear and stress and while they were blue in the face on the brink of death. They did not look like patients dying of pneumonia. You can see why they don't want autopsies when their virus doesn't exist and there is another condition in some people that they don't wish to be uncovered. I should add here that

the 5G system of millimetre waves was being rapidly introduced around the world in 2020 and even more so now as they fire 5G at the Earth from satellites. At 60 gigahertz within the 5G range that frequency interacts with the oxygen molecule and stops people breathing in sufficient oxygen to be absorbed into the bloodstream. They are installing 5G in schools and hospitals. The world is not mad or anything. 5G can cause major changes to the lungs and blood as I detail in *The Answer* and these consequences are labelled 'Covid-19', the alleged symptoms of which can be caused by 5G and other electromagnetic frequencies as cells respond to radiation poisoning.

The 'Covid death' scam

Dr Scott Jensen, a Minnesota state senator and medical doctor, exposed 'Covid' Medicare payment incentives to hospitals and death certificate manipulation. He said he was sent a seven-page document by the US Department of Health 'coaching' him on how to fill out death certificates which had never happened before. The document said that he didn't need to have a laboratory test for 'Covid-19' to put that on the death certificate and that shocked him when death certificates are supposed to be about facts. Jensen described how doctors had been 'encouraged, if not pressured' to make a diagnosis of 'Covid-19' if they thought it was probable or *'presumed*'. No positive test was necessary – not that this would have mattered anyway. He said doctors were told to diagnose 'Covid' by symptoms when these were the same as colds, allergies, other respiratory problems, and certainly with influenza which 'disappeared' in the 'Covid' era. A common sniffle was enough to get the dreaded verdict. Ontario authorities decreed that a single care home resident with *one* symptom from a long list must lead to the isolation of the entire home. Other courageous doctors like Jensen made the same point about death figure manipulation and how deaths by other causes were falling while 'Covid-19 deaths' were rising at the same rate due to re-diagnosis. Their videos rarely survive long on YouTube with its Cult-supporting algorithms courtesy of CEO Susan Wojcicki and her bosses at Google. Figure-tampering was so glaring

and ubiquitous that even officials were letting it slip or outright saying it. UK chief scientific adviser Patrick Vallance said on one occasion that 'Covid' on the death certificate doesn't mean 'Covid' was the cause of death (so why the hell is it there?) and we had the rare sight of a BBC reporter telling the truth when she said: 'Someone could be successfully treated for Covid, in say April, discharged, and then in June, get run over by a bus and die … That person would still be counted as a Covid death in England.' Yet the BBC and the rest of the world media went on repeating the case and death figures as if they were real. Illinois Public Health Director Dr Ngozi Ezike revealed the deceit while her bosses must have been clenching their buttocks:

> If you were in a hospice and given a few weeks to live and you were then found to have Covid that would be counted as a Covid death. [There might be] a clear alternate cause, but it is still listed as a Covid death. So everyone listed as a Covid death doesn't mean that was the cause of the death, but that they had Covid at the time of death.

Yes, a 'Covid virus' never shown to exist and tested for with a test not testing for the 'virus'. In the first period of the pandemic hoax through the spring of 2020 the process began of designating almost everything a 'Covid' death and this has continued ever since. I sat in a restaurant one night listening to a loud conversation on the next table where a family was discussing in bewilderment how a relative who had no symptoms of 'Covid', and had died of a long-term problem, could have been diagnosed a death by the 'virus'. I could understand their bewilderment. If they read this book they will know why this medical fraud has been perpetrated the world over.

Some media truth shock

The media ignored the evidence of death certificate fraud until eventually one columnist did speak out when she saw it first-hand. Bel Mooney is a long-time national newspaper journalist in Britain currently working for the *Daily Mail*. Her article on February 19th, 2021, carried this headline: 'My dad Ted passed three Covid tests

and died of a chronic illness yet he's officially one of Britain's 120,000 victims of the virus and is far from alone ... so how many more are there?' She told how her 99-year-old father was in a care home with a long-standing chronic obstructive pulmonary disease and vascular dementia. Maybe, but he was still aware enough to tell her from the start that there was no 'virus' and he refused the 'vaccine' for that reason. His death was not unexpected given his chronic health problems and Mooney said she was shocked to find that 'Covid-19' was declared the cause of death on his death certificate. She said this was a 'bizarre and unacceptable untruth' for a man with long-time health problems who had tested negative twice at the home for the 'virus'. I was also shocked by this story although not by what she said. I had been highlighting the death certificate manipulation for ten months. It was the confirmation that a professional full-time journalist only realised this was going on when it affected her directly and neither did she know that whether her dad tested positive or negative was irrelevant with the test not testing for the 'virus'. Where had she been? She said she did not believe in 'conspiracy theories' without knowing I'm sure that this and 'conspiracy theorists' were terms put into widespread circulation by the CIA in the 1960s to discredit those who did not accept the ridiculous official story of the Kennedy assassination. A blanket statement of 'I don't believe in conspiracy theories' is always bizarre. The dictionary definition of the term alone means the world is drowning in conspiracies. What she said was even more daft when her dad had just been affected by the 'Covid' conspiracy. Why else does she think that 'Covid-19' was going on the death certificates of people who died of something else?

To be fair once she saw from personal experience what was happening she didn't mince words. Mooney was called by the care home on the morning of February 9th to be told her father had died in his sleep. When she asked for the official cause of death what came back was 'Covid-19'. Mooney challenged this and was told there had been deaths from Covid on the dementia floor (confirmed by a test not testing for the 'virus') so they considered it 'reasonable

to assume'. 'But doctor,' Mooney rightly protested, 'an assumption isn't a diagnosis.' She said she didn't blame the perfectly decent and sympathetic doctor – 'he was just doing his job'. Sorry, but that's *bullshit*. He wasn't doing his job at all. He was putting a false cause of death on the death certificate and that is a criminal offence for which he should be brought to account and the same with the millions of doctors worldwide who have done the same. They were not doing their job they were following orders and that must not wash at new Nuremberg trials any more than it did at the first ones. Mooney's doctor was 'assuming' (presuming) as he was told to, but 'just following orders' makes no difference to his actions. A doctor's job is to serve the patient and the truth, not follow orders, but that's what they have done all over the world and played a central part in making the 'Covid' hoax possible with all its catastrophic consequences for humanity. Shame on them and they must answer for their actions. Mooney said her disquiet worsened when she registered her father's death by telephone and was told by the registrar there had been very many other cases like hers where 'the deceased' had not tested positive for 'Covid' yet it was recorded as the cause of death. The test may not matter, but those involved at their level *think* it matters and it shows a callous disregard for accurate diagnosis. The pressure to do this is coming from the top of the national 'health' pyramids which in turn obey the World Health Organization which obeys Gates and the Cult. Mooney said the registrar agreed that this must distort the national figures adding that 'the strangest thing is that every winter we record countless deaths from flu, and this winter there have been none. Not one!' She asked if the registrar thought deaths from flu were being misdiagnosed and lumped together with 'Covid' deaths. The answer was a 'puzzled yes'. Mooney said that the funeral director said the same about 'Covid' deaths which had nothing to do with 'Covid'. They had lost count of the number of families upset by this and other funeral companies in different countries have had the same experience. Mooney wrote:

The nightly shroud-waving and shocking close-ups of pain imposed on us by the TV news bewildered and terrified the population into eager compliance with lockdowns. We were invited to 'save the NHS' and to grieve for strangers – the real-life loved ones behind those shocking death counts. Why would the public imagine what I now fear, namely that the way Covid-19 death statistics are compiled might make the numbers seem greater than they are?

Oh, just a little bit – like 100 percent.

Do the maths

Mooney asked why a country would wish to skew its mortality figures by wrongly certifying deaths? What had been going on? Well, if you don't believe in conspiracies you will never find the answer which is that *it's a conspiracy*. She did, however, describe what she had discovered as a 'national scandal'. In reality it's a global scandal and happening everywhere. Pillars of this conspiracy were all put into place before the button was pressed with the Drosten PCR protocol and high amplifications to produce the cases and death certificate changes to secure illusory 'Covid' deaths. Mooney notes that normally two doctors were needed to certify a death, with one having to know the patient, and how the rules were changed in the spring of 2020 to allow one doctor to do this. In the same period 'Covid deaths' were decreed to be all cases where Covid-19 was put on the death certificate even without a positive test or any symptoms. Mooney asked: 'How many of the 30,851 (as of January 15) care home resident deaths with Covid-19 on the certificate (32.4 per cent of all deaths so far) were based on an assumption, like that of my father? And what has that done to our national psyche?'All of them is the answer to the first question and it has devastated and dismantled the national psyche, actually the global psyche, on a colossal scale. In the UK case and death data is compiled by organisations like Public Health England (PHE) and the Office for National Statistics (ONS). Mooney highlights the insane policy of counting a death from any cause as 'Covid-19' if this happens within 28 days of a positive test (with a test not testing for the 'virus') and she points out that ONS statistics reflect deaths 'involving Covid' 'or due to Covid' which meant in practice any

death where 'Covid-19' was mentioned on the death certificate. She described the consequences of this fraud:

Most people will accept the narrative they are fed, so panicky governments here and in Europe witnessed the harsh measures enacted in totalitarian China and jumped into lockdown. Headlines about Covid deaths tolled like the knell that would bring doomsday to us all. Fear stalked our empty streets. Politicians parroted the frankly ridiculous aim of 'zero Covid' and shut down the economy, while most British people agreed that lockdown was essential and (astonishingly to me, as a patriotic Brit) even wanted more restrictions.

For what? Lies on death certificates? Never mind the grim toll of lives ruined, suicides, schools closed, rising inequality, depression, cancelled hospital treatments, cancer patients in a torture of waiting, poverty, economic devastation, loneliness, families kept apart, and so on. How many lives have been lost as a direct result of lockdown?

She said that we could join in a national chorus of shock and horror at reaching the 120,000 death toll which was surely certain to have been totally skewed all along, but what about the human cost of lockdown justified by these 'death figures'? *The British Medical Journal* had reported a 1,493 percent increase in cases of children taken to Great Ormond Street Hospital with abusive head injuries alone and then there was the effect on families:

Perhaps the most shocking thing about all this is that families have been kept apart – and obeyed the most irrational, changing rules at the whim of government – because they believed in the statistics. They succumbed to fear, which his generation rejected in that war fought for freedom. Dad (God rest his soul) would be angry. And so am I.

Another theme to watch is that in the winter months when there are more deaths from all causes they focus on 'Covid' deaths and in the summer when the British Lung Foundation says respiratory disease plummets by 80 percent they rage on about 'cases'. Either way fascism on population is always the answer.

Nazi eugenics in the 21st century

Elderly people in care homes have been isolated from their families month after lonely month with no contact with relatives and grandchildren who were banned from seeing them. We were told

that lockdown fascism was to 'protect the vulnerable' like elderly people. At the same time Do Not Resuscitate (DNR) orders were placed on their medical files so that if they needed resuscitation it wasn't done and 'Covid-19' went on their death certificates. Old people were not being 'protected' they were being culled – murdered in truth. DNR orders were being decreed for disabled and young people with learning difficulties or psychological problems. The UK Care Quality Commission, a non-departmental body of the Department of Health and Social Care, found that 34 percent of those working in health and social care were pressured into placing 'do not attempt cardiopulmonary resuscitation' orders on 'Covid' patients who suffered from disabilities and learning difficulties without involving the patient or their families in the decision. UK judges ruled that an elderly woman with dementia should have the DNA-manipulating 'Covid vaccine' against her son's wishes and that a man with severe learning difficulties should have the jab despite his family's objections. Never mind that many had already died. The judiciary always supports doctors and government in fascist dictatorships. They wouldn't dare do otherwise. A horrific video was posted showing fascist officers from Los Angeles police forcibly giving the 'Covid' shot to women with special needs who were screaming that they didn't want it. The same fascists are seen giving the jab to a sleeping elderly woman in a care home. This is straight out of the Nazi playbook. Hitler's Nazis committed mass murder of the mentally ill and physically disabled throughout Germany and occupied territories in the programme that became known as Aktion T4, or just T4. Sabbatian-controlled Hitler and his grotesque crazies set out to kill those they considered useless and unnecessary. The Reich Committee for the Scientific Registering of Hereditary and Congenital Illnesses registered the births of babies identified by physicians to have 'defects'. By 1941 alone more than 5,000 children were murdered by the state and it is estimated that in total the number of innocent people killed in Aktion T4 was between 275,000 and 300,000. Parents were told their children had been sent away for 'special treatment' never to return. It is rather pathetic to see claims about plans for new extermination camps being dismissed today

when the same force behind current events did precisely that 80 years ago. Margaret Sanger was a Cult operative who used 'birth control' to sanitise her programme of eugenics. Organisations she founded became what is now Planned Parenthood. Sanger proposed that 'the whole dysgenic population would have its choice of segregation or sterilization'. These included epileptics, 'feeble-minded', and prostitutes. Sanger opposed charity because it perpetuated 'human waste'. She reveals the Cult mentality and if anyone thinks that extermination camps are a 'conspiracy theory' their naivety is touching if breathtakingly stupid.

If you don't believe that doctors can act with callous disregard for their patients it is worth considering that doctors and medical staff agreed to put government-decreed DNR orders on medical files and do nothing when resuscitation is called for. I don't know what you call such people in your house. In mine they are Nazis from the Josef Mengele School of Medicine. Phenomenal numbers of old people have died worldwide from the effects of lockdown, depression, lack of treatment, the 'vaccine' (more later) and losing the will to live. A common response at the start of the manufactured pandemic was to remove old people from hospital beds and transfer them to nursing homes. The decision would result in a mass cull of elderly people in those homes through lack of treatment – *not* 'Covid'. Care home whistleblowers have told how once the 'Covid' era began doctors would not come to their homes to treat patients and they were begging for drugs like antibiotics that often never came. The most infamous example was ordered by New York governor Andrew Cuomo, brother of a moronic CNN host, who amazingly was given an Emmy Award for his handling of the 'Covid crisis' by the ridiculous Wokers that hand them out. Just how ridiculous could be seen in February, 2021, when a Department of Justice and FBI investigation began into how thousands of old people in New York died in nursing homes after being discharged from hospital to make way for 'Covid' patients on Cuomo's say-so – and how he and his staff covered up these facts. This couldn't have happened to a nicer psychopath. Even then there was a 'Covid' spin. Reports said that

thousands of old people who tested positive for 'Covid' in hospital were transferred to nursing homes to both die of 'Covid' and transmit it to others. No – they were in hospital because they were ill and the fact that they tested positive with a test not testing for the 'virus' is irrelevant. They were ill often with respiratory diseases ubiquitous in old people near the end of their lives. Their transfer out of hospital meant that their treatment stopped and many would go on to die.

They're old. Who gives a damn?

I have exposed in the books for decades the Cult plan to cull the world's old people and even to introduce at some point what they call a 'demise pill' which at a certain age everyone would take and be out of here by law. In March, 2021, Spain legalised euthanasia and assisted suicide following the Netherlands, Belgium, Luxembourg and Canada on the Tiptoe to the demise pill. Treatment of old people by many 'care' homes has been a disgrace in the 'Covid' era. There are many, many, caring staff – I know some. There have, however, been legions of stories about callous treatment of old people and their families. Police were called when families came to take their loved ones home in the light of isolation that was killing them. They became prisoners of the state. Care home residents in insane, fascist Ontario, Canada, were not allowed to leave their *room* once the 'Covid' hoax began. UK staff have even wheeled elderly people away from windows where family members were talking with them. Oriana Criscuolo from Stockport in the English North West dropped off some things for her 80-year-old father who has Parkinson's disease and dementia and she wanted to wave to him through a ground-floor window. She was told that was 'illegal'. When she went anyway they closed the curtains in the middle of the day. Oriana said:

> It's just unbelievable. I cannot understand how care home staff – people who are being paid to care – have become so uncaring. Their behaviour is inhumane and cruel. It's beyond belief.

She was right and this was not a one-off. What a way to end your life in such loveless circumstances. UK registered nurse Nicky Millen, a proper old school nurse for 40 years, said that when she started her career care was based on dignity, choice, compassion and empathy. Now she said 'the things that are important to me have gone out of the window.' She was appalled that people were dying without their loved ones and saying goodbye on iPads. Nicky described how a distressed 89-year-old lady stroked her face and asked her 'how many paracetamol would it take to finish me off'. Life was no longer worth living while not seeing her family. Nicky said she was humiliated in front of the ward staff and patients for letting the lady stroke her face and giving her a cuddle. Such is the dehumanisation that the 'Covid' hoax has brought to the surface. Nicky worked in care homes where patients told her they were being held prisoner. 'I want to live until I die', one said to her. 'I had a lady in tears because she hadn't seen her great-grandson.' Nicky was compassionate old school meeting psychopathic New Normal. She also said she had worked on a 'Covid' ward with no 'Covid' patients. Jewish writer Shai Held wrote an article in March, 2020, which was headlined 'The Staggering, Heartless Cruelty Toward the Elderly'. What he described was happening from the earliest days of lockdown. He said 'the elderly' were considered a group and not unique individuals (the way of the Woke). Shai Held said:

Notice how the all-too-familiar rhetoric of dehumanization works: 'The elderly' are bunched together as a faceless mass, all of them considered culprits and thus effectively deserving of the suffering the pandemic will inflict upon them. Lost entirely is the fact that the elderly are individual human beings, each with a distinctive face and voice, each with hopes and dreams, memories and regrets, friendships and marriages, loves lost and loves sustained.

'The elderly' have become another dehumanised group for which anything goes and for many that has resulted in cold disregard for their rights and their life. The distinctive face that Held talks about is designed to be deleted by masks until everyone is part of a faceless mass.

‘War-zone’ hospitals myth

Again and again medical professionals have told me what was really going on and how hospitals ‘overrun like war zones’ according to the media were virtually empty. The mantra from medical whistleblowers was please don’t use my name or my career is over. Citizen journalists around the world sneaked into hospitals to film evidence exposing the ‘war-zone’ lie. They really *were* largely empty with closed wards and operating theatres. I met a hospital worker in my town on the Isle of Wight during the first lockdown in 2020 who said the only island hospital had never been so quiet. Lockdown was justified by the psychopaths to stop hospitals being overrun. At the same time that the island hospital was near-empty the military arrived here to provide *extra beds*. It was all propaganda to ramp up the fear to ensure compliance with fascism as were never-used temporary hospitals with thousands of beds known as Nightingales and never-used make-shift mortuaries opened by the criminal UK government. A man who helped to install those extra island beds attributed to the army said they were never used and the hospital was empty. Doctors and nurses ‘stood around talking or on their phones, wandering down to us to see what we were doing’. There were no masks or social distancing. He accused the useless local island paper, the *County Press*, of ‘pumping the fear as if our hospital was overrun and we only have one so it should have been’. He described ambulances parked up with crews outside in deck chairs. When his brother called an ambulance he was told there was a two-hour backlog which he called ‘bullshit’. An old lady on the island fell ‘and was in a bad way’, but a caller who rang for an ambulance was told the situation wasn’t urgent enough. Ambulance stations were working under capacity while people would hear ambulances with sirens blaring driving through the streets. When those living near the stations realised what was going on they would follow them as they left, circulated around an urban area with the sirens going, and then came back without stopping. All this was to increase levels of fear and the same goes for the ‘ventilator shortage crisis’ that cost tens of millions for hastily produced ventilators never to be used.

Ambulance crews that agreed to be exploited in this way for fear propaganda might find themselves a mirror. I wish them well with that. Empty hospitals were the obvious consequence of treatment and diagnoses of non-'Covid' conditions cancelled and those involved handed a death sentence. People have been dying at home from undiagnosed and untreated cancer, heart disease and other life-threatening conditions to allow empty hospitals to deal with a 'pandemic' that wasn't happening.

Death of the innocent

'War-zones' have been laying off nursing staff, even doctors where they can. There was no work for them. Lockdown was justified by saving lives and protecting the vulnerable they were actually killing with DNR orders and preventing empty hospitals being 'overrun'. In Britain the mantra of stay at home to 'save the NHS' was everywhere and across the world the same story was being sold when it was all lies. Two California doctors, Dan Erickson and Artin Massihi at Accelerated Urgent Care in Bakersfield, held a news conference in April, 2020, to say that intensive care units in California were 'empty, essentially', with hospitals shutting floors, not treating patients and laying off doctors. The California health system was working at minimum capacity 'getting rid of doctors because we just don't have the volume'. They said that people with conditions such as heart disease and cancer were not coming to hospital out of fear of 'Covid-19'. Their video was deleted by Susan Wojcicki's Cult-owned YouTube after reaching five million views. Florida governor Ron Desantis, who rejected the severe lockdowns of other states and is being targeted for doing so, said that in March, 2020, every US governor was given models claiming they would run out of hospital beds in days. That was never going to happen and the 'modellers' knew it. Deceit can be found at every level of the system. Urgent children's operations were cancelled including fracture repairs and biopsies to spot cancer. Eric Nicholls, a consultant paediatrician, said 'this is obviously concerning and we need to return to normal operating and to increase capacity as soon as possible'. Psychopaths

in power were rather less concerned *because* they are psychopaths. Deletion of urgent care and diagnosis has been happening all over the world and how many kids and others have died as a result of the actions of these cold and heartless lunatics dictating 'health' policy? The number must be stratospheric. Richard Sullivan, professor of cancer and global health at King's College London, said people feared 'Covid' more than cancer such was the campaign of fear. 'Years of lost life will be quite dramatic', Sullivan said, with 'a huge amount of avoidable mortality'. Sarah Woolnough, executive director for policy at Cancer Research UK, said there had been a 75 percent drop in urgent referrals to hospitals by family doctors of people with suspected cancer. Sullivan said that 'a lot of services have had to scale back – we've seen a dramatic decrease in the amount of elective cancer surgery'. Lockdown deaths worldwide has been absolutely fantastic with the *New York Post* reporting how data confirmed that 'lockdowns end more lives than they save':

> There was a sharp decline in visits to emergency rooms and an increase in fatal heart attacks because patients didn't receive prompt treatment. Many fewer people were screened for cancer. Social isolation contributed to excess deaths from dementia and Alzheimer's.
>
> Researchers predicted that the social and economic upheaval would lead to tens of thousands of "deaths of despair" from drug overdoses, alcoholism and suicide. As unemployment surged and mental-health and substance-abuse treatment programs were interrupted, the reported levels of anxiety, depression and suicidal thoughts increased dramatically, as did alcohol sales and fatal drug overdoses.

This has been happening while nurses and other staff had so much time on their hands in the 'war-zones' that Tic-Tok dancing videos began appearing across the Internet with medical staff dancing around in empty wards and corridors as people died at home from causes that would normally have been treated in hospital.

Mentions in dispatches

One brave and truth-committed whistleblower was Louise Hampton, a call handler with the UK NHS who made a viral Internet video saying she had done 'fuck all' during the 'pandemic'

which was 'a load of bollocks'. She said that 'Covid-19' was rebranded flu and of course she lost her job. This is what happens in the medical and endless other professions now when you tell the truth. Louise filmed inside 'war-zone' accident and emergency departments to show they were empty and I mean *empty* as in no one there. The mainstream media could have done the same and blown the gaff on the whole conspiracy. They haven't to their eternal shame. Not that most 'journalists' seem capable of manifesting shame as with the psychopaths they slavishly repeat without question. The relative few who were admitted with serious health problems were left to die alone with no loved ones allowed to see them because of 'Covid' rules and they included kids dying without the comfort of mum and dad at their bedside while the evil behind this couldn't give a damn. It was all good fun to them. A Scottish NHS staff nurse publicly quit in the spring of 2021 saying: 'I can no longer be part of the lies and the corruption by the government.' She said hospitals 'aren't full, the beds aren't full, beds have been shut, wards have been shut'. Hospitals were never busy throughout 'Covid'. The staff nurse said that Nicola Sturgeon, tragically the leader of the Scottish government, was on television saying save the hospitals and the NHS – 'but the beds are empty' and 'we've not seen flu, we always see flu every year'. She wrote to government and spoke with her union Unison (the unions are Cult-compromised and *useless*, but nothing changed. Many of her colleagues were scared of losing their jobs if they spoke out as they wanted to. She said nursing staff were being affected by wearing masks all day and 'my head is splitting every shift from wearing a mask'. The NHS is part of the fascist tyranny and must be dismantled so we can start again with human beings in charge. (Ironically, hospitals were reported to be busier again when official 'Covid' cases *fell* in spring/summer of 2021 and many other conditions required treatment at the same time as *the fake vaccine rollout*.)

I will cover the 'Covid vaccine' scam in detail later, but it is another indicator of the sickening disregard for human life that I am highlighting here. The DNA-manipulating concoctions do not fulfil

the definition of a 'vaccine', have never been used on humans before and were given only emergency approval because trials were not completed and they continued using the unknowing public. The result was what a NHS senior nurse with responsibility for 'vaccine' procedure said was 'genocide'. She said the 'vaccines' were not 'vaccines'. They had not been shown to be safe and claims about their effectiveness by drug companies were 'poetic licence'. She described what was happening as a 'horrid act of human annihilation'. The nurse said that management had instigated a policy of not providing a Patient Information Leaflet (PIL) before people were 'vaccinated' even though health care professionals are supposed to do this according to protocol. Patients should also be told that they are taking part in an ongoing clinical trial. Her challenges to what is happening had seen her excluded from meetings and ridiculed in others. She said she was told to 'watch my step … or I would find myself surplus to requirements'. The nurse, who spoke anonymously in fear of her career, said she asked her NHS manager why he/she was content with taking part in genocide against those having the 'vaccines'. The reply was that everyone had to play their part and to 'put up, shut up, and get it done'. Government was 'leaning heavily' on NHS management which was clearly leaning heavily on staff. This is how the global 'medical' hierarchy operates and it starts with the Cult and its World Health Organization.

She told the story of a doctor who had the Pfizer jab and when questioned had no idea what was in it. The doctor had never read the literature. We have to stop treating doctors as intellectual giants when so many are moral and medical pygmies. The doctor did not even know that the 'vaccines' were not fully approved or that their trials were ongoing. They were, however, asking their patients if they minded taking part in follow-ups for research purposes – yes, the *ongoing clinical trial*. The nurse said the doctor's ignorance was not rare and she had spoken to a hospital consultant who had the jab without any idea of the background or that the 'trials' had not been completed. Nurses and pharmacists had shown the same ignorance.

'My NHS colleagues have forsaken their duty of care, broken their code of conduct – Hippocratic Oath – and have been brainwashed just the same as the majority of the UK public through propaganda …' She said she had not been able to recruit a single NHS colleague, doctor, nurse or pharmacist to stand with her and speak out. Her union had refused to help. She said that if the genocide came to light she would not hesitate to give evidence at a Nuremberg-type trial against those in power who could have affected the outcomes but didn't.

And all for what?

To put the nonsense into perspective let's say the 'virus' does exist and let's go completely crazy and accept that the official manipulated figures for cases and deaths are accurate. *Even then* a study by Stanford University epidemiologist Dr John Ioannidis published on the World Health Organization website produced an average infection to fatality rate of … *0.23 percent!* Ioannidis said: 'If one could sample equally from all locations globally, the median infection fatality rate might even be substantially lower than the 0.23% observed in my analysis.' For healthy people under 70 it was … *0.05 percent*! This compares with the 3.4 percent claimed by the Cult-owned World Health Organization when the hoax was first played and maximum fear needed to be generated. An updated Stanford study in April, 2021, put the 'infection' to 'fatality' rate at just 0.15 percent. Another team of scientists led by Megan O'Driscoll and Henrik Salje studied data from 45 countries and published their findings on the Nature website. For children and young people the figure is so small it virtually does not register although authorities will be hyping dangers to the young when they introduce DNA-manipulating 'vaccines' for children. The O'Driscoll study produced an average infection-fatality figure of 0.003 for children from birth to four; 0.001 for 5 to 14; 0.003 for 15 to 19; and it was still only 0.456 up to 64. To claim that children must be 'vaccinated' to protect them from 'Covid' is an obvious lie and so there must be another reason and there is. What's more the average age of a 'Covid' death is akin

to the average age that people die in general. The average age of death in England is about 80 for men and 83 for women. The average age of death from alleged 'Covid' is between 82 and 83. California doctors, Dan Erickson and Artin Massihi, said at their April media conference that projection models of millions of deaths had been 'woefully inaccurate'. They produced detailed figures showing that Californians had a 0.03 chance of dying from 'Covid' based on the number of people who tested positive (with a test not testing for the 'virus'). Erickson said there was a 0.1 percent chance of dying from 'Covid' in the *state* of New York, not just the city, and a 0.05 percent chance in Spain, a centre of 'Covid-19' hysteria at one stage. The Stanford studies supported the doctors' data with fatality rate estimates of 0.23 and 0.15 percent. How close are these figures to my estimate of *zero*? Death-rate figures claimed by the World Health Organization at the start of the hoax were some 15 times higher. The California doctors said there was no justification for lockdowns and the economic devastation they caused. Everything they had ever learned about quarantine was that you quarantine the *sick* and not the healthy. They had never seen this before and it made no medical sense.

Why in the in the light of all this would governments and medical systems the world over say that billions must go under house arrest; lose their livelihood; in many cases lose their mind, their health and their life; force people to wear masks dangerous to health and psychology; make human interaction and even family interaction a criminal offence; ban travel; close restaurants, bars, watching live sport, concerts, theatre, and any activity involving human togetherness and discourse; and closing schools to isolate children from their friends and cause many to commit suicide in acts of hopelessness and despair? The California doctors said lockdown consequences included increased child abuse, partner abuse, alcoholism, depression, and other impacts they were seeing every day. Who would do that to the entire human race if not mentally-ill psychopaths of almost unimaginable extremes like Bill Gates? We must face the reality of what we are dealing with and come out of

denial. Fascism and tyranny are made possible only by the target population submitting and acquiescing to fascism and tyranny. The whole of human history shows that to be true. Most people naively and unquestioning believed what they were told about a 'deadly virus' and meekly and weakly submitted to house arrest. Those who didn't believe it – at least in total – still submitted in fear of the consequences of not doing so. For the rest who wouldn't submit draconian fines have been imposed, brutal policing by psychopaths *for* psychopaths, and condemnation from the meek and weak who condemn the Pushbackers on behalf of the very force that has them, too, in its gunsights. 'Pathetic' does not even begin to suffice. Britain's brainless 'Health' Secretary Matt Hancock warned anyone lying to border officials about returning from a list of 'hotspot' countries could face a jail sentence of up to ten years which is more than for racially-aggravated assault, incest and attempting to have sex with a child under 13. Hancock is a lunatic, but he has the state apparatus behind him in a Cult-led chain reaction and the same with UK 'Vaccine Minister' Nadhim Zahawi, a prominent member of the mega-Cult secret society, Le Cercle, which featured in my earlier books. The Cult enforces its will on governments and medical systems; government and medical systems enforce their will on business and police; business enforces its will on staff who enforce it on customers; police enforce the will of the Cult on the population and play their essential part in creating a world of fascist control that their own children and grandchildren will have to live in their entire lives. It is a hierarchical pyramid of imposition and acquiescence and, yes indeedy, of clinical insanity.

Does anyone bright enough to read this book have to ask what the answer is? I think not, but I will reveal it anyway in the fewest of syllables: Tell the psychos and their moronic lackeys to fuck off and let's get on with our lives. We are many – They are few.

CHAPTER SEVEN

War on your mind

One believes things because one has been conditioned to believe them
Aldous Huxley, *Brave New World*

I have described the 'Covid' hoax as a 'Psyop' and that is true in every sense and on every level in accordance with the definition of that term which is psychological warfare. Break down the 'Covid pandemic' to the foundation themes and it is psychological warfare on the human individual and collective mind.

The same can be said for the entire human belief system involving every subject you can imagine. Huxley was right in his contention that people believe what they are conditioned to believe and this comes from the repetition throughout their lives of the same falsehoods. They spew from government, corporations, media and endless streams of 'experts' telling you what the Cult wants you to believe and often believing it themselves (although *far* from always). 'Experts' are rewarded with 'prestigious' jobs and titles and as agents of perceptual programming with regular access to the media. The Cult has to control the narrative – control *information* – or they lose control of the vital, crucial, without-which-they-cannot-prevail public perception of reality. The foundation of that control today is the Internet made possible by the Defense Advanced Research Projects Agency (DARPA), the incredibly sinister technological arm of the Pentagon. The Internet is the result of military technology.

DARPA openly brags about establishing the Internet which has been a long-term project to lasso the minds of the global population. I have said for decades the plan is to control information to such an extreme that eventually no one would see or hear anything that the Cult does not approve. We are closing in on that end with ferocious censorship since the 'Covid' hoax began and in my case it started back in the 1990s in terms of books and speaking venues. I had to create my own publishing company in 1995 precisely because no one else would publish my books even then. I think they're all still running.

Cult Internet

To secure total control of information they needed the Internet in which pre-programmed algorithms can seek out 'unclean' content for deletion and even stop it being posted in the first place. The Cult had to dismantle print and non-Internet broadcast media to ensure the transfer of information to the appropriate-named 'Web' – a critical expression of the *Cult* web. We've seen the ever-quickening demise of traditional media and control of what is left by a tiny number of corporations operating worldwide. Independent journalism in the mainstream is already dead and never was that more obvious than since the turn of 2020. The Cult wants all information communicated via the Internet to globally censor and allow the plug to be pulled any time. Lockdowns and forced isolation has meant that communication between people has been through electronic means and no longer through face-to-face discourse and discussion. Cult psychopaths have targeted the bars, restaurants, sport, venues and meeting places in general for this reason. None of this is by chance and it's to stop people gathering in any kind of privacy or number while being able to track and monitor all Internet communications and block them as necessary. Even private messages between individuals have been censored by these fascists that control Cult fronts like Facebook, Twitter, Google and YouTube which are all officially run by Sabbatian place-people and from the background by higher-level Sabbatian place people.

Facebook, Google, Amazon and their like were seed-funded and supported into existence with money-no-object infusions of funds either directly or indirectly from DARPA and CIA technology arm In-Q-Tel. The Cult plays the long game and prepares very carefully for big plays like 'Covid'. Amazon is another front in the psychological war and pretty much controls the global market in book sales and increasingly publishing. Amazon's limitless funds have deleted fantastic numbers of independent publishers to seize global domination on the way to deciding which books can be sold and circulated and which cannot. Moves in that direction are already happening. Amazon's leading light Jeff Bezos is the grandson of Lawrence Preston Gise who worked with DARPA predecessor ARPA. Amazon has big connections to the CIA and the Pentagon. The plan I have long described went like this:

1. Employ military technology to establish the Internet.

2. Sell the Internet as a place where people can freely communicate without censorship and allow that to happen until the Net becomes the central and irreversible pillar of human society. If the Internet had been highly censored from the start many would have rejected it.

3. Fund and manipulate major corporations into being to control the circulation of information on your Internet using cover stories about geeks in garages to explain how they came about. Give them unlimited funds to expand rapidly with no need to make a profit for years while non-Cult companies who need to balance the books cannot compete. You know that in these circumstances your Googles, YouTubes, Facebooks and Amazons are going to secure near monopolies by either crushing or buying up the opposition.

4. Allow freedom of expression on both the Internet and communication platforms to draw people in until the Internet is the central and irreversible pillar of human society and your communication corporations have reached a stage of near monopoly domination.

5. Then unleash your always-planned frenzy of censorship on the basis of 'where else are you going to go?' and continue to expand that until nothing remains that the Cult does not want its human targets to see.

The process was timed to hit the 'Covid' hoax to ensure the best chance possible of controlling the narrative which they knew they had to do at all costs. They were, after all, about to unleash a 'deadly virus' that didn't really exist. If you do that in an environment of free-flowing information and opinion you would be dead in the

water before you could say Gates is a psychopath. The network was in place through which the Cult-created-and-owned World Health Organization could dictate the 'Covid' narrative and response policy slavishly supported by Cult-owned Internet communication giants and mainstream media while those telling a different story were censored. Google, YouTube, Facebook and Twitter openly announced that they would do this. What else would we expect from Cult-owned operations like Facebook which former executives have confirmed set out to make the platform more addictive than cigarettes and coldly manipulates emotions of its users to sow division between people and groups and scramble the minds of the young? If Zuckerberg lives out the rest of his life without going to jail for crimes against humanity, and most emphatically against the young, it will be a travesty of justice. Still, no matter, cause and effect will catch up with him eventually and the same with Sergey Brin and Larry Page at Google with its CEO Sundar Pichai who fix the Google search results to promote Cult narratives and hide the opposition. Put the same key words into Google and other search engines like DuckDuckGo and you will see how different results can be. Wikipedia is another intensely biased 'encyclopaedia' which skews its content to the Cult agenda. YouTube links to Wikipedia's version of 'Covid' and 'climate change' on video pages in which experts in their field offer a different opinion (even that is increasingly rare with Wojcicki censorship). Into this 'Covid' silence-them network must be added government media censors, sorry 'regulators', such as Ofcom in the UK which imposed tyrannical restrictions on British broadcasters that had the effect of banning me from ever appearing. Just to debate with me about my evidence and views on 'Covid' would mean breaking the fascistic impositions of Ofcom and its CEO career government bureaucrat Melanie Dawes. Gutless British broadcasters tremble at the very thought of fascist Ofcom.

Psychos behind 'Covid'

The reason for the 'Covid' catastrophe in all its facets and forms can be seen by whom and what is driving the policies worldwide in such a coordinated way. Decisions are not being made to protect health, but to target psychology. The dominant group guiding and 'advising' government policy are not medical professionals. They are psychologists and behavioural scientists. Every major country has its own version of this phenomenon and I'll use the British example to show how it works. In many ways the British version has been affecting the wider world in the form of the huge behaviour manipulation network in the UK which operates in other countries. The network involves private companies, government, intelligence and military. The Cabinet Office is at the centre of the government 'Covid' Psyop and part-owns, with 'innovation charity' Nesta, the Behavioural Insights Team (BIT) which claims to be independent of government but patently isn't. The BIT was established in 2010 and its job is to manipulate the psyche of the population to acquiesce to government demands and so much more. It is also known as the 'Nudge Unit', a name inspired by the 2009 book by two ultra-Zionists, Cass Sunstein and Richard Thaler, called *Nudge: Improving Decisions About Health, Wealth, and Happiness*. The book, as with the Behavioural Insights Team, seeks to 'nudge' behaviour (manipulate it) to make the public follow patterns of action and perception that suit those in authority (the Cult). Sunstein is so skilled at this that he advises the World Health Organization and the UK Behavioural Insights Team and was Administrator of the White House Office of Information and Regulatory Affairs in the Obama administration. Biden appointed him to the Department of Homeland Security – another ultra-Zionist in the fold to oversee new immigration laws which is another policy the Cult wants to control. Sunstein is desperate to silence anyone exposing conspiracies and co-authored a 2008 report on the subject in which suggestions were offered to ban 'conspiracy theorizing' or impose 'some kind of tax, financial or otherwise, on those who disseminate such theories'. I guess a psychiatrist's chair is out of the question?

Sunstein's mate Richard Thaler, an 'academic affiliate' of the UK Behavioural Insights Team, is a proponent of 'behavioural economics' which is defined as the study of 'the effects of psychological, cognitive, emotional, cultural and social factors on the decisions of individuals and institutions'. Study the effects so they can be manipulated to be what you want them to be. Other leading names in the development of behavioural economics are ultra-Zionists Daniel Kahneman and Robert J. Shiller and they, with Thaler, won the Nobel Memorial Prize in Economic Sciences for their work in this field. The Behavioural Insights Team is operating at the heart of the UK government and has expanded globally through partnerships with several universities including Harvard, Oxford, Cambridge, University College London (UCL) and Pennsylvania. They claim to have 'trained' (reframed) 20,000 civil servants and run more than 750 projects involving 400 randomised controlled trials in dozens of countries' as another version of mind reframers Common Purpose. BIT works from its office in New York with cities and their agencies, as well as other partners, across the United States and Canada – this is a company part-owned by the British government Cabinet Office. An executive order by President Cult-servant Obama established a US Social and Behavioral Sciences Team in 2015. They all have the same reason for being and that's to brainwash the population directly and by brainwashing those in positions of authority.

'Covid' mind game

Another prime aspect of the UK mind-control network is the 'independent' [joke] Scientific Pandemic Insights Group on Behaviours (SPI-B) which 'provides behavioural science advice aimed at anticipating and helping people adhere to interventions that are recommended by medical or epidemiological experts'. That means manipulating public perception and behaviour to do whatever government tells them to do. It's disgusting and if they really want the public to be 'safe' this lot should all be under lock and key. According to the government website SPI-B consists of

'behavioural scientists, health and social psychologists, anthropologists and historians' and advises the Whitty-Vallance-led Scientific Advisory Group for Emergencies (SAGE) which in turn advises the government on 'the science' (it doesn't) and 'Covid' policy. When politicians say they are being guided by 'the science' this is the rabble in each country they are talking about and that 'science' is dominated by behaviour manipulators to enforce government fascism through public compliance. The Behaviour Insight Team is headed by psychologist David Solomon Halpern, a visiting professor at King's College London, and connects with a national and global web of other civilian and military organisations as the Cult moves towards its goal of fusing them into one fascistic whole in every country through its 'Fusion Doctrine'. The behaviour manipulation network involves, but is not confined to, the Foreign Office; National Security Council; government communications headquarters (GCHQ); MI5; MI6; the Cabinet Office-based Media Monitoring Unit; and the Rapid Response Unit which 'monitors digital trends to spot emerging issues; including misinformation and disinformation; and identifies the best way to respond'.

There is also the 77th Brigade of the UK military which operates like the notorious Israeli military's Unit 8200 in manipulating information and discussion on the Internet by posing as members of the public to promote the narrative and discredit those who challenge it. Here we have the military seeking to manipulate *domestic* public opinion while the Nazis in government are fine with that. Conservative Member of Parliament Tobias Ellwood, an advocate of lockdown and control through 'vaccine passports', is a Lieutenant Colonel reservist in the 77th Brigade which connects with the military operation jHub, the 'innovation centre' for the Ministry of Defence and Strategic Command. jHub has also been involved with the civilian National Health Service (NHS) in 'symptom tracing' the population. The NHS is a key part of this mind control network and produced a document in December, 2020, explaining to staff how to use psychological manipulation with different groups and ages to get them to have the DNA-manipulating 'Covid vaccine'

that's designed to cumulatively rewrite human genetics. The document, called 'Optimising Vaccination Roll Out – Do's and Dont's for all messaging, documents and "communications" in the widest sense', was published by NHS England and the NHS Improvement *Behaviour Change Unit* in partnership with Public Health England and Warwick Business School. I hear the mantra about 'save the NHS' and 'protect the NHS' when we need to scrap the NHS and start again. The current version is far too corrupt, far too anti-human and totally compromised by Cult operatives and their assets. UK government broadcast media censor Ofcom will connect into this web – as will the BBC with its tremendous Ofcom influence – to control what the public see and hear and dictate mass perception. Nuremberg trials must include personnel from all these organisations.

The fear factor

The 'Covid' hoax has led to the creation of the UK Cabinet Office-connected Joint Biosecurity Centre (JBC) which is officially described as providing 'expert advice on pandemics' using its independent [all Cult operations are 'independent'] analytical function to provide real-time analysis about infection outbreaks to identify and respond to outbreaks of Covid-19'. Another role is to advise the government on a response to spikes in infections – 'for example by closing schools or workplaces in local areas where infection levels have risen'. Put another way, promoting the Cult agenda. The Joint Biosecurity Centre is modelled on the Joint Terrorism Analysis Centre which analyses intelligence to set 'terrorism threat levels' and here again you see the fusion of civilian and military operations and intelligence that has led to military intelligence producing documents about 'vaccine hesitancy' and how it can be combated. Domestic civilian matters and opinions should not be the business of the military. The Joint Biosecurity Centre is headed by Tom Hurd, director general of the Office for Security and Counter-Terrorism from the establishment-to-its-fingertips Hurd family. His father is former Foreign Secretary Douglas Hurd. How coincidental that Tom

Hurd went to the elite Eton College and Oxford University with Boris Johnson. Imperial College with its ridiculous computer modeller Neil Ferguson will connect with this gigantic web that will itself interconnect with similar set-ups in other major and not so major countries. Compared with this Cult network the politicians, be they Boris Johnson, Donald Trump or Joe Biden, are bit-part players 'following the science'. The network of psychologists was on the 'Covid' case from the start with the aim of generating maximum fear of the 'virus' to ensure compliance by the population. A government behavioural science group known as SPI-B produced a paper in March, 2020, for discussion by the main government science advisory group known as SAGE. It was headed 'Options for increasing adherence to social distancing measures' and it said the following in a section headed 'Persuasion':

- A substantial number of people still do not feel sufficiently personally threatened; it could be that they are reassured by the low death rate in their demographic group, although levels of concern may be rising. Having a good understanding of the risk has been found to be positively associated with adoption of COVID-19 social distancing measures in Hong Kong.

- The perceived level of personal threat needs to be increased among those who are complacent, using hard-hitting evaluation of options for increasing social distancing emotional messaging. To be effective this must also empower people by making clear the actions they can take to reduce the threat.

- Responsibility to others: There seems to be insufficient understanding of, or feelings of responsibility about, people's role in transmitting the infection to others … Messaging about actions need to be framed positively in terms of protecting oneself and the community, and increase confidence that they will be effective.

- Some people will be more persuaded by appeals to play by the rules, some by duty to the community, and some to personal risk.

> All these different approaches are needed. The messaging also needs to take account of the realities of different people's lives. Messaging needs to take account of the different motivational levers and circumstances of different people.

All this could be achieved the SPI-B psychologists said by *using the media to increase the sense of personal threat* which translates as terrify the shit out of the population, including children, so they all do what we want. That's not happened has it? Those excuses for 'journalists' who wouldn't know journalism if it bit them on the arse (the great majority) have played their crucial part in serving this Cult-government Psyop to enslave their own kids and grandkids. How they live with themselves I have no idea. The psychological war has been underpinned by constant government 'Covid' propaganda in almost every television and radio ad break, plus the Internet and print media, which has pounded out the fear with taxpayers footing the bill for their own programming. The result has been people terrified of a 'virus' that doesn't exist or one with a tiny fatality rate even if you believe it does. People walk down the street and around the shops wearing face-nappies damaging their health and psychology while others report those who refuse to be that naïve to the police who turn up in their own face-nappies. I had a cameraman come to my flat and he was so frightened of 'Covid' he came in wearing a mask and refused to shake my hand in case he caught something. He had – naïveitis – and the thought that he worked in the mainstream media was both depressing and made his behaviour perfectly explainable. The fear which has gripped the minds of so many and frozen them into compliance has been carefully cultivated by these psychologists who are really psychopaths. If lives get destroyed and a lot of young people commit suicide it shows our plan is working. SPI-B then turned to compulsion on the public to comply. 'With adequate preparation, rapid change can be achieved', it said. Some countries had introduced mandatory self-isolation on a wide scale without evidence of major public unrest and a large majority of the UK's population appeared to be supportive of more coercive measures with 64 percent of adults saying they would

support putting London under a lockdown (watch the 'polls' which are designed to make people believe that public opinion is in favour or against whatever the subject in hand).

For 'aggressive protective measures' to be effective, the SPI-B paper said, special attention should be devoted to those population groups that are more at risk. Translated from the Orwellian this means making the rest of population feel guilty for not protecting the 'vulnerable' such as old people which the Cult and its agencies were about to kill on an industrial scale with lockdown, lack of treatment and the Gates 'vaccine'. Psychopath psychologists sold their guilt-trip so comprehensively that Los Angeles County Supervisor Hilda Solis reported that children were apologising (from a distance) to their parents and grandparents for bringing 'Covid' into their homes and getting them sick. '… These apologies are just some of the last words that loved ones will ever hear as they die alone,' she said. Gut-wrenchingly Solis then used this childhood tragedy to tell children to stay at home and 'keep your loved ones alive'. Imagine heaping such potentially life-long guilt on a kid when it has absolutely nothing to do with them. These people are deeply disturbed and the psychologists behind this even more so.

Uncivil war – divide and rule

Professional mind-controllers at SPI-B wanted the media to increase a sense of responsibility to others (do as you're told) and promote 'positive messaging' for those actions while in contrast to invoke 'social disapproval' by the unquestioning, obedient, community of anyone with a mind of their own. Again the compliant Goebbels-like media obliged. This is an old, old, trick employed by tyrannies the world over throughout human history. You get the target population to keep the target population in line – *your* line. SPI-B said this could 'play an important role in preventing anti-social behaviour or discouraging failure to enact pro-social behaviour'. For 'anti-social' in the Orwellian parlance of SPI-B see any behaviour that government doesn't approve. SPI-B recommendations said that 'social disapproval' should be accompanied by clear messaging and

promotion of strong collective identity – hence the government and celebrity mantra of 'we're all in this together'. Sure we are. The mind doctors have such contempt for their targets that they think some clueless comedian, actor or singer telling them to do what the government wants will be enough to win them over. We have had UK comedian Lenny Henry, actor Michael Caine and singer Elton John wheeled out to serve the propagandists by urging people to have the DNA-manipulating 'Covid' non-'vaccine'. The role of Henry and fellow black celebrities in seeking to coax a 'vaccine' reluctant black community into doing the government's will was especially stomach-turning. An emotion-manipulating script and carefully edited video featuring these black 'celebs' was such an insult to the intelligence of black people and where's the self-respect of those involved selling their souls to a fascist government agenda? Henry said he heard black people's 'legitimate worries and concerns', but people must 'trust the facts' when they were doing exactly that by not having the 'vaccine'. They had to include the obligatory reference to Black Lives Matter with the line … 'Don't let coronavirus cost even more black lives – because we matter'. My god, it was pathetic. 'I know the vaccine is safe and what it does.' How? 'I'm a comedian and it says so in my script.'

SPI-B said social disapproval needed to be carefully managed to avoid victimisation, scapegoating and misdirected criticism, but they knew that their 'recommendations' would lead to exactly that and the media were specifically used to stir-up the divide-and-conquer hostility. Those who conform like good little baa, baas, are praised while those who have seen through the tidal wave of lies are 'Covidiots'. The awake have been abused by the fast asleep for not conforming to fascism and impositions that the awake know are designed to endanger their health, dehumanise them, and tear asunder the very fabric of human society. We have had the curtain-twitchers and morons reporting neighbours and others to the face-nappied police for breaking 'Covid rules' with fascist police delighting in posting links and phone numbers where this could be done. The Cult cannot impose its will without a compliant police

and military or a compliant population willing to play their part in enslaving themselves and their kids. The words of a pastor in Nazi Germany are so appropriate today:

First they came for the socialists and I did not speak out because I was not a socialist.

Then they came for the trade unionists and I did not speak out because I was not a trade unionist.

Then they came for the Jews and I did not speak out because I was not a Jew.

Then they came for me and there was no one left to speak for me.

Those who don't learn from history are destined to repeat it and so many are.

'Covid' rules: Rewiring the mind

With the background laid out to this gigantic national and global web of psychological manipulation we can put 'Covid' rules into a clear and sinister perspective. Forget the claims about protecting health. 'Covid' rules are about dismantling the human mind, breaking the human spirit, destroying self-respect, and then putting Humpty Dumpty together again as a servile, submissive slave. Social isolation through lockdown and distancing have devastating effects on the human psyche as the psychological psychopaths well know and that's the real reason for them. Humans need contact with each other, discourse, closeness and touch, or they eventually, and literarily, go crazy. Masks, which I will address at some length, fundamentally add to the effects of isolation and the Cult agenda to dehumanise and de-individualise the population. To do this while knowing – in fact *seeking* – this outcome is the very epitome of evil and psychologists involved in this *are* the epitome of evil. They must like all the rest of the Cult demons and their assets stand trial for crimes against humanity on a scale that defies the imagination. Psychopaths in uniform use isolation to break enemy troops and agents and make them subservient and submissive to tell what they know. The technique is rightly considered a form of torture and

torture is most certainly what has been imposed on the human population.

Clinically-insane American psychologist Harry Harlow became famous for his isolation experiments in the 1950s in which he separated baby monkeys from their mothers and imprisoned them for months on end in a metal container or 'pit of despair'. They soon began to show mental distress and depression as any idiot could have predicted. Harlow put other monkeys in steel chambers for three, six or twelve months while denying them any contact with animals or humans. He said that the effects of total social isolation for six months were 'so devastating and debilitating that we had assumed initially that twelve months of isolation would not produce any additional decrement'; but twelve months of isolation 'almost obliterated the animals socially'. This is what the Cult and its psychopaths are doing to you and your children. Even monkeys in partial isolation in which they were not allowed to form relationships with other monkeys became 'aggressive and hostile, not only to others, but also towards their own bodies'. We have seen this in the young as a consequence of lockdown. UK government psychopaths launched a public relations campaign telling people not to hug each other even after they received the 'Covid-19 vaccine' which we were told with more lies would allow a return to 'normal life'. A government source told *The Telegraph*: 'It will be along the lines that it is great that you have been vaccinated, but if you are going to visit your family and hug your grandchildren there is a chance you are going to infect people you love.' The source was apparently speaking from a secure psychiatric facility. Janet Lord, director of Birmingham University's Institute of Inflammation and Ageing, said that parents and grandparents should avoid hugging their children. Well, how can I put it, Ms Lord? Fuck off. Yep, that'll do.

Destroying the kids – where are the parents?

Observe what has happened to people enslaved and isolated by lockdown as suicide and self-harm has soared worldwide,

particularly among the young denied the freedom to associate with their friends. A study of 49,000 people in English-speaking countries concluded that almost half of young adults are at clinical risk of mental health disorders. A national survey in America of 1,000 currently enrolled high school and college students found that 5 percent reported attempting suicide during the pandemic. Data from the US CDC's National Syndromic Surveillance Program from January 1st to October 17th, 2020, revealed a *31 percent* increase in mental health issues among adolescents aged 12 to 17 compared with 2019. The CDC reported that America in general suffered the biggest drop in life expectancy since World War Two as it fell by a year in the first half of 2020 as a result of 'deaths of despair' – overdoses and suicides. Deaths of despair have leapt by more than 20 percent during lockdown and include the highest number of fatal overdoses ever recorded in a single year – 81,000. Internet addiction is another consequence of being isolated at home which lowers interest in physical activities as kids fall into inertia and what's the point? Children and young people are losing hope and giving up on life, sometimes literally. A 14-year-old boy killed himself in Maryland because he had 'given up' when his school district didn't reopen; an 11-year-old boy shot himself during a zoom class; a teenager in Maine succumbed to the isolation of the 'pandemic' when he ended his life after experiencing a disrupted senior year at school. Children as young as nine have taken their life and all these stories can be repeated around the world. Careers are being destroyed before they start and that includes those in sport in which promising youngsters have not been able to take part. The plan of the psycho-psychologists is working all right. Researchers at Cambridge University found that lockdowns cause significant harm to children's mental health. Their study was published in the *Archives of Disease in Childhood*, and followed 168 children aged between 7 and 11. The researchers concluded:

> During the UK lockdown, children's depression symptoms have increased substantially, relative to before lockdown. The scale of this effect has direct relevance for the continuation of different elements of lockdown policy, such as complete or partial school closures …

… Specifically, we observed a statistically significant increase in ratings of depression, with a medium-to-large effect size. Our findings emphasise the need to incorporate the potential impact of lockdown on child mental health in planning the ongoing response to the global pandemic and the recovery from it.

Not a chance when the Cult's psycho-psychologists were getting exactly what they wanted. The UK's Royal College of Paediatrics and Child Health has urged parents to look for signs of eating disorders in children and young people after a three to four fold increase. Specialists say the 'pandemic' is a major reason behind the rise. You don't say. The College said isolation from friends during school closures, exam cancellations, loss of extra-curricular activities like sport, and an increased use of social media were all contributory factors along with fears about the virus (psycho-psychologists again), family finances, and students being forced to quarantine. Doctors said young people were becoming severely ill by the time they were seen with 'Covid' regulations reducing face-to-face consultations. Nor is it only the young that have been devastated by the psychopaths. Like all bullies and cowards the Cult is targeting the young, elderly, weak and infirm. A typical story was told by a British lady called Lynn Parker who was not allowed to visit her husband in 2020 for the last ten and half months of his life 'when he needed me most' between March 20th and when he died on December 19th. This vacates the criminal and enters the territory of evil. The emotional impact on the immune system alone is immense as are the number of people of all ages worldwide who have died as a result of Cult-demanded, Gates-demanded, lockdowns.

Isolation is torture

The experience of imposing solitary confinement on millions of prisoners around the world has shown how a large percentage become 'actively psychotic and/or acutely suicidal'. Social isolation has been found to trigger 'a specific psychiatric syndrome, characterized by hallucinations; panic attacks; overt paranoia; diminished impulse control; hypersensitivity to external stimuli; and difficulties with thinking, concentration and memory'. Juan Mendez,

a United Nations rapporteur (investigator), said that isolation is a form of torture. Research has shown that even after isolation prisoners find it far more difficult to make social connections and I remember chatting to a shop assistant after one lockdown who told me that when her young son met another child again he had no idea how to act or what to do. Hannah Flanagan, Director of Emergency Services at Journey Mental Health Center in Dane County, Wisconsin, said: 'The specificity about Covid social distancing and isolation that we've come across as contributing factors to the suicides are really new to us this year.' But they are not new to those that devised them. They are getting the effect they want as the population is psychologically dismantled to be rebuilt in a totally different way. Children and the young are particularly targeted. They will be the adults when the full-on fascist AI-controlled technocracy is planned to be imposed and they are being prepared to meekly submit. At the same time older people who still have a memory of what life was like before – and how fascist the new normal really is – are being deleted. You are going to see efforts to turn the young against the old to support this geriatric genocide. Hannah Flanagan said the big increase in suicide in her county proved that social isolation is not only harmful, but deadly. Studies have shown that isolation from others is one of the main risk factors in suicide and even more so with women. Warnings that lockdown could create a 'perfect storm' for suicide were ignored. After all this was one of the *reasons* for lockdown. Suicide, however, is only the most extreme of isolation consequences. There are many others. Dr Dhruv Khullar, assistant professor of healthcare policy at Weill Cornell Medical College, said in a *New York Times* article in 2016 long before the fake 'pandemic':

> A wave of new research suggests social separation is bad for us. Individuals with less social connection have disrupted sleep patterns, altered immune systems, more inflammation and higher levels of stress hormones. One recent study found that isolation increases the risk of heart disease by 29 percent and stroke by 32 percent. Another analysis that pooled data from 70 studies and 3.4 million people found that socially isolated individuals had a 30 percent higher risk of dying in the next seven years, and that this effect was largest in middle age.

Loneliness can accelerate cognitive decline in older adults, and isolated individuals are twice as likely to die prematurely as those with more robust social interactions. These effects start early: Socially isolated children have significantly poorer health 20 years later, even after controlling for other factors. All told, loneliness is as important a risk factor for early death as obesity and smoking.

There you have proof from that one article alone four years before 2020 that those who have enforced lockdown, social distancing and isolation knew what the effect would be and that is even more so with professional psychologists that have been driving the policy across the globe. We can go back even further to the years 2000 and 2003 and the start of a major study on the effects of isolation on health by Dr Janine Gronewold and Professor Dirk M. Hermann at the University Hospital in Essen, Germany, who analysed data on 4,316 people with an average age of 59 who were recruited for the long-term research project. They found that socially isolated people are more than 40 percent more likely to have a heart attack, stroke, or other major cardiovascular event and nearly 50 percent more likely to die from any cause. Given the financial Armageddon unleashed by lockdown we should note that the study found a relationship between increased cardiovascular risk and lack of financial support. After excluding other factors social isolation was still connected to a 44 percent increased risk of cardiovascular problems and a 47 percent increased risk of death by any cause. Lack of financial support was associated with a 30 percent increase in the risk of cardiovascular health events. Dr Gronewold said it had been known for some time that feeling lonely or lacking contact with close friends and family can have an impact on physical health and the study had shown that having strong social relationships is of high importance for heart health. Gronewold said they didn't understand yet why people who are socially isolated have such poor health outcomes, but this was obviously a worrying finding, particularly during these times of prolonged social distancing. Well, it can be explained on many levels. You only have to identify the point in the body where people feel loneliness and missing people they are parted from – it's in the centre of the chest where they feel the ache of loneliness and the ache of missing people. 'My heart aches for

you' … 'My heart aches for some company.' I will explain this more in the chapter Escaping Wetiko, but when you realise that the body is the mind – they are expressions of each other – the reason why state of the mind dictates state of the body becomes clear.

American psychologist Ranjit Powar was highlighting the effects of lockdown isolation as early as April, 2020. She said humans have evolved to be social creatures and are wired to live in interactive groups. Being isolated from family, friends and colleagues could be unbalancing and traumatic for most people and could result in short or even long-term psychological and physical health problems. An increase in levels of anxiety, aggression, depression, forgetfulness and hallucinations were possible psychological effects of isolation. 'Mental conditions may be precipitated for those with underlying pre-existing susceptibilities and show up in many others without any pre-condition.' Powar said personal relationships helped us cope with stress and if we lost this outlet for letting off steam the result can be a big emotional void which, for an average person, was difficult to deal with. 'Just a few days of isolation can cause increased levels of anxiety and depression' – so what the hell has been the effect on the global population of *18 months* of this at the time of writing? Powar said: 'Add to it the looming threat of a dreadful disease being repeatedly hammered in through the media and you have a recipe for many shades of mental and physical distress.' For those with a house and a garden it is easy to forget that billions have had to endure lockdown isolation in tiny overcrowded flats and apartments with nowhere to go outside. The psychological and physical consequences of this are unimaginable and with lunatic and abusive partners and parents the consequences have led to tremendous increases in domestic and child abuse and alcoholism as people seek to shut out the horror. Ranjit Powar said:

Staying in a confined space with family is not all a rosy picture for everyone. It can be extremely oppressive and claustrophobic for large low-income families huddled together in small single-room houses. Children here are not lucky enough to have many board/electronic games or books to keep them occupied.

Add to it the deep insecurity of running out of funds for food and basic necessities. On the other hand, there are people with dysfunctional family dynamics, such as domineering, abusive or alcoholic partners, siblings or parents which makes staying home a period of trial. Incidence of suicide and physical abuse against women has shown a worldwide increase. Heightened anxiety and depression also affect a person's immune system, making them more susceptible to illness.

To think that Powar's article was published on April 11th, 2020.

Six-feet fantasy

Social (unsocial) distancing demanded that people stay six feet or two metres apart. UK government advisor Robert Dingwall from the New and Emerging Respiratory Virus Threats Advisory Group said in a radio interview that the two-metre rule was 'conjured up out of nowhere' and was not based on science. No, it was not based on *medical* science, but it didn't come out of nowhere. The distance related to *psychological* science. Six feet/two metres was adopted in many countries and we were told by people like the criminal Anthony Fauci and his ilk that it was founded on science. Many schools could not reopen because they did not have the space for six-feet distancing. Then in March, 2021, after a year of six-feet 'science', a study published in the *Journal of Infectious Diseases* involving more than 500,000 students and almost 100,000 staff over 16 weeks revealed no significant difference in 'Covid' cases between six feet and three feet and Fauci changed his tune. Now three feet was okay. There is no difference between six feet and three *inches* when there is no 'virus' and they got away with six feet for psychological reasons for as long as they could. I hear journalists and others talk about 'unintended consequences' of lockdown. They are not *unintended* at all; they have been coldly-calculated for a specific outcome of human control and that's why super-psychopaths like Gates have called for them so vehemently. Super-psychopath psychologists have demanded them and psychopathic or clueless, spineless, politicians have gone along with them by 'following the science'. But it's not science at all. 'Science' is not what is; it's only what people can be manipulated to believe it is. The whole 'Covid' catastrophe is

founded on mind control. Three word or three statement mantras issued by the UK government are a well-known mind control technique and so we've had 'Stay home/protect the NHS/save lives', 'Stay alert/control the virus/save lives' and 'hands/face/space'. One of the most vocal proponents of extreme 'Covid' rules in the UK has been Professor Susan Michie, a member of the British Communist Party, who is not a medical professional. Michie is the director of the Centre for Behaviour Change at University College London. She is a *behavioural psychologist* and another filthy rich 'Marxist' who praised China's draconian lockdown. She was known by fellow students at Oxford University as 'Stalin's nanny' for her extreme Marxism. Michie is an influential member of the UK government's Scientific Advisory Group for Emergencies (SAGE) and behavioural manipulation groups which have dominated 'Covid' policy. She is a consultant adviser to the World Health Organization on 'Covid-19' and behaviour. Why the hell are lockdowns anything to do with her when they are claimed to be about health? Why does a behavioural psychologist from a group charged with changing the behaviour of the public want lockdown, human isolation and mandatory masks? Does that question really need an answer? Michie *absolutely* has to explain herself before a Nuremberg court when humanity takes back its world again and even more so when you see the consequences of masks that she demands are compulsory. This is a Michie classic:

> The benefits of getting primary school children to wear masks is that regardless of what little degree of transmission is occurring in those age groups it could help normalise the practice. Young children wearing masks may be more likely to get their families to accept masks.

Those words alone should carry a prison sentence when you ponder on the callous disregard for children involved and what a statement it makes about the mind and motivations of Susan Michie. What a lovely lady and what she said there encapsulates the mentality of the psychopaths behind the 'Covid' horror. Let us compare what Michie said with a countrywide study in Germany published at researchsquare.com involving 25,000 school children and 17,854 health complaints submitted by parents. Researchers

found that masks are harming children physically, psychologically, and behaviourally with 24 health issues associated with mask wearing. They include: shortness of breath (29.7%); dizziness (26.4%); increased headaches (53%); difficulty concentrating (50%); drowsiness or fatigue (37%); and malaise (42%). Nearly a third of children experienced more sleep issues than before and a quarter developed new fears. Researchers found health issues and other impairments in 68 percent of masked children covering their faces for an average of 4.5 hours a day. Hundreds of those taking part experienced accelerated respiration, tightness in the chest, weakness, and short-term impairment of consciousness. A reminder of what Michie said again:

The benefits of getting primary school children to wear masks is that regardless of what little degree of transmission is occurring in those age groups it could help normalise the practice. Young children wearing masks may be more likely to get their families to accept masks.

Psychopaths in government and psychology now have children and young people – plus all the adults – wearing masks for hours on end while clueless teachers impose the will of the psychopaths on the young they should be protecting. What the hell are parents doing?

Cult lab rats

We have some schools already imposing on students microchipped buzzers that activate when they get 'too close' to their pals in the way they do with lab rats. How apt. To the Cult and its brain-dead servants our children *are* lab rats being conditioned to be unquestioning, dehumanised slaves for the rest of their lives. Children and young people are being weaned and frightened away from the most natural human instincts including closeness and touch. I have tracked in the books over the years how schools were banning pupils from greeting each other with a hug and the whole Cult-induced Me Too movement has terrified men and boys from a relaxed and natural interaction with female friends and work colleagues to the point where many men try never to be in a room

alone with a woman that's not their partner. Airhead celebrities have as always played their virtue-signalling part in making this happen with their gross exaggeration. For every monster like Harvey Weinstein there are at least tens of thousands of men that don't treat women like that; but everyone must be branded the same and policy changed for them as well as the monster. I am going to be using the word 'dehumanise' many times in this chapter because that is what the Cult is seeking to do and it goes very deep as we shall see. Don't let them kid you that social distancing is planned to end one day. That's not the idea. We are seeing more governments and companies funding and producing wearable gadgets to keep people apart and they would not be doing that if this was meant to be short-term. A tech start-up company backed by GCHQ, the British Intelligence and military surveillance headquarters, has created a social distancing wrist sensor that alerts people when they get too close to others. The CIA has also supported tech companies developing similar devices. The wearable sensor was developed by Tended, one of a number of start-up companies supported by GCHQ (see the CIA and DARPA). The device can be worn on the wrist or as a tag on the waistband and will vibrate whenever someone wearing the device breaches social distancing and gets anywhere near natural human contact. The company had a lucky break in that it was developing a distancing sensor when the 'Covid' hoax arrived which immediately provided a potentially enormous market. How fortunate. The government in big-time Cult-controlled Ontario in Canada is investing $2.5 million in wearable contact tracing technology that 'will alert users if they may have been exposed to the Covid-19 in the workplace and will beep or vibrate if they are within six feet of another person'. Facedrive Inc., the technology company behind this, was founded in 2016 with funding from the Ontario Together Fund and obviously they, too, had a prophet on the board of directors. The human surveillance and control technology is called TraceSCAN and would be worn by the human cyborgs in places such as airports, workplaces, construction sites, care homes and … *schools*.

I emphasise schools with children and young people the prime targets. You know what is planned for society as a whole if you keep your eyes on the schools. They have always been places where the state program the next generation of slaves to be its compliant worker-ants – or Woker-ants these days; but in the mist of the 'Covid' madness they have been transformed into mind laboratories on a scale never seen before. Teachers and head teachers are just as programmed as the kids – often more so. Children are kept apart from human interaction by walk lanes, classroom distancing, staggered meal times, masks, and the rolling-out of buzzer systems. Schools are now physically laid out as a laboratory maze for lab-rats. Lunatics at a school in Anchorage, Alaska, who should be prosecuted for child abuse, took away desks and forced children to kneel (know your place) on a mat for five hours a day while wearing a mask and using their chairs as a desk. How this was supposed to impact on a 'virus' only these clinically insane people can tell you and even then it would be clap-trap. The school banned recess (interaction), art classes (creativity), and physical exercise (getting body and mind moving out of inertia). Everyone behind this outrage should be in jail or better still a mental institution. The behavioural manipulators are all for this dystopian approach to schools. Professor Susan Michie, the mind-doctor and British Communist Party member, said it was wrong to say that schools were safe. They had to be made so by 'distancing', masks and ventilation (sitting all day in the cold). I must ask this lady round for dinner on a night I know I am going to be out and not back for weeks. She probably wouldn't be able to make it, anyway, with all the visits to her own psychologist she must have block-booked.

Masking identity

I know how shocking it must be for you that a behaviour manipulator like Michie wants everyone to wear masks which have long been a feature of mind-control programs like the infamous MKUltra in the United States, but, there we are. We live and learn. I spent many years from 1996 to right across the millennium

researching mind control in detail on both sides of the Atlantic and elsewhere. I met a large number of mind-control survivors and many had been held captive in body and mind by MKUltra. MK stands for mind-control, but employs the German spelling in deference to the Nazis spirited out of Germany at the end of World War Two by Operation Paperclip in which the US authorities, with help from the Vatican, transported Nazi mind-controllers and engineers to America to continue their work. Many of them were behind the creation of NASA and they included Nazi scientist and SS officer Wernher von Braun who swapped designing V-2 rockets to bombard London with designing the Saturn V rockets that powered the NASA moon programme's Apollo craft. I think I may have mentioned that the Cult has no borders. Among Paperclip escapees was Josef Mengele, the Angel of Death in the Nazi concentration camps where he conducted mind and genetic experiments on children often using twins to provide a control twin to measure the impact of his 'work' on the other. If you want to observe the Cult mentality in all its extremes of evil then look into the life of Mengele. I have met many people who suffered mercilessly under Mengele in the United States where he operated under the name Dr Greene and became a stalwart of MKUltra programming and torture. Among his locations was the underground facility in the Mojave Desert in California called the China Lake Naval Weapons Station which is almost entirely below the surface. My books *The Biggest Secret*, *Children of the Matrix* and *The Perception Deception* have the detailed background to MKUltra.

The best-known MKUltra survivor is American Cathy O'Brien. I first met her and her late partner Mark Phillips at a conference in Colorado in 1996. Mark helped her escape and deprogram from decades of captivity in an offshoot of MKUltra known as Project Monarch in which 'sex slaves' were provided for the rich and famous including Father George Bush, Dick Cheney and the Clintons. Read Cathy and Mark's book *Trance-Formation of America* and if you are new to this you will be shocked to the core. I read it in 1996 shortly before, with the usual synchronicity of my life, I found

myself given a book table at the conference right next to hers. MKUltra never ended despite being very publicly exposed (only a small part of it) in the 1970s and continues in other guises. I am still in touch with Cathy. She contacted me during 2020 after masks became compulsory in many countries to tell me how they were used as part of MKUltra programming. I had been observing 'Covid regulations' and the relationship between authority and public for months. I saw techniques that I knew were employed on individuals in MKUltra being used on the global population. I had read many books and manuals on mind control including one called *Silent Weapons for Quiet Wars* which came to light in the 1980s and was a guide on how to perceptually program on a mass scale. 'Silent Weapons' refers to mind-control. I remembered a line from the manual as governments, medical authorities and law enforcement agencies have so obviously talked to – or rather at – the adult population since the 'Covid' hoax began as if they are children. The document said:

> If a person is spoken to by a T.V. advertiser as if he were a twelve-year-old, then, due to suggestibility, he will, with a certain probability, respond or react to that suggestion with the uncritical response of a twelve-year-old and will reach in to his economic reservoir and deliver its energy to buy that product on impulse when he passes it in the store.

That's why authority has spoken to adults like children since all this began.

Why did Michael Jackson wear masks?

Every aspect of the 'Covid' narrative has mind-control as its central theme. Cathy O'Brien wrote an article for davidicke.com about the connection between masks and mind control. Her daughter Kelly who I first met in the 1990s was born while Cathy was still held captive in MKUltra. Kelly was forced to wear a mask as part of her programming from the age of *two* to dehumanise her, target her sense of individuality and reduce the amount of oxygen her brain and body received. *Bingo*. This is the real reason for compulsory

masks, why they have been enforced en masse, and why they seek to increase the number they demand you wear. First one, then two, with one disgraceful alleged 'doctor' recommending four which is nothing less than a death sentence. Where and how often they must be worn is being expanded for the purpose of mass mind control and damaging respiratory health which they can call 'Covid-19'. Canada's government headed by the man-child Justin Trudeau, says it's fine for children of two and older to wear masks. An insane 'study' in Italy involving just 47 children concluded there was no problem for babies as young as *four months* wearing them. Even after people were 'vaccinated' they were still told to wear masks by the criminal that is Anthony Fauci. Cathy wrote that mandating masks is allowing the authorities literally to control the air we breathe which is what was done in MKUltra. You might recall how the singer Michael Jackson wore masks and there is a reason for that. He was subjected to MKUltra mind control through Project Monarch and his psyche was scrambled by these simpletons. Cathy wrote:

In MKUltra Project Monarch mind control, Michael Jackson had to wear a mask to silence his voice so he could not reach out for help. Remember how he developed that whisper voice when he wasn't singing? Masks control the mind from the outside in, like the redefining of words is doing. By controlling what we can and cannot say for fear of being labeled racist or beaten, for example, it ultimately controls thought that drives our words and ultimately actions (or lack thereof).

Likewise, a mask muffles our speech so that we are not heard, which controls voice … words … mind. This is Mind Control. Masks are an obvious mind control device, and I am disturbed so many people are complying on a global scale. Masks depersonalize while making a person feel as though they have no voice. It is a barrier to others. People who would never choose to comply but are forced to wear a mask in order to keep their job, and ultimately their family fed, are compromised. They often feel shame and are subdued. People have stopped talking with each other while media controls the narrative.

The 'no voice' theme has often become literal with train passengers told not to speak to each other in case they pass on the 'virus', singing banned for the same reason and bonkers California officials telling people riding roller coasters that they cannot shout and scream. Cathy said she heard every day from healed MKUltra survivors who cannot wear a mask without flashing back on ways

their breathing was controlled – 'from ball gags and penises to water boarding'. She said that through the years when she saw images of people in China wearing masks 'due to pollution' that it was really to control their oxygen levels. 'I knew it was as much of a population control mechanism of depersonalisation as are burkas', she said. Masks are another Chinese communist/fascist method of control that has been swept across the West as the West becomes China at lightning speed since we entered 2020.

Mask-19

There are other reasons for mandatory masks and these include destroying respiratory health to call it 'Covid-19' and stunting brain development of children and the young. Dr Margarite Griesz-Brisson MD, PhD, is a Consultant Neurologist and Neurophysiologist and the Founder and Medical Director of the London Neurology and Pain Clinic. Her CV goes down the street and round the corner. She is clearly someone who cares about people and won't parrot the propaganda. Griesz-Brisson has a PhD in pharmacology, with special interest in neurotoxicology, environmental medicine, neuroregeneration and neuroplasticity (the way the brain can change in the light of information received). She went public in October, 2020, with a passionate warning about the effects of mask-wearing laws:

> The reinhalation of our exhaled air will without a doubt create oxygen deficiency and a flooding of carbon dioxide. We know that the human brain is very sensitive to oxygen deprivation. There are nerve cells for example in the hippocampus that can't be longer than 3 minutes without oxygen – they cannot survive. The acute warning symptoms are headaches, drowsiness, dizziness, issues in concentration, slowing down of reaction time – reactions of the cognitive system.

Oh, I know, let's tell bus, truck and taxi drivers to wear them and people working machinery. How about pilots, doctors and police? Griesz-Brisson makes the important point that while the symptoms she mentions may fade as the body readjusts this does not alter the fact that people continue to operate in oxygen deficit with long list of

potential consequences. She said it was well known that neurodegenerative diseases take years or decades to develop. 'If today you forget your phone number, the breakdown in your brain would have already started 20 or 30 years ago.' She said degenerative processes in your brain are getting amplified as your oxygen deprivation continues through wearing a mask. Nerve cells in the brain are unable to divide themselves normally in these circumstances and lost nerve cells will no longer be regenerated. 'What is gone is gone.' Now consider that people like shop workers and *schoolchildren* are wearing masks for hours every day. What in the name of sanity is going to be happening to them? 'I do not wear a mask, I need my brain to think', Griesz-Brisson said, 'I want to have a clear head when I deal with my patients and not be in a carbon dioxide-induced anaesthesia'. If you are told to wear a mask anywhere ask the organisation, police, store, whatever, for their risk assessment on the dangers and negative effects on mind and body of enforcing mask-wearing. They won't have one because it has never been done not even by government. All of them must be subject to class-action lawsuits as the consequences come to light. They don't do mask risk assessments for an obvious reason. They know what the conclusions would be and independent scientific studies that *have* been done tell a horror story of consequences.

'Masks are criminal'

Dr Griesz-Brisson said that for children and adolescents, masks are an absolute no-no. They had an extremely active and adaptive immune system and their brain was incredibly active with so much to learn. 'The child's brain, or the youth's brain, is thirsting for oxygen.' The more metabolically active an organ was, the more oxygen it required; and in children and adolescents every organ was metabolically active. Griesz-Brisson said that to deprive a child's or adolescent's brain of oxygen, or to restrict it in any way, was not only dangerous to their health, it was absolutely criminal. 'Oxygen deficiency inhibits the development of the brain, and the damage that has taken place as a result CANNOT be reversed.' Mind

manipulators of MKUltra put masks on two-year-olds they wanted to neurologically rewire and you can see why. Griesz-Brisson said a child needs the brain to learn and the brain needs oxygen to function. 'We don't need a clinical study for that. This is simple, indisputable physiology.' Consciously and purposely induced oxygen deficiency was an absolutely deliberate health hazard, and an absolute medical contraindication which means that 'this drug, this therapy, this method or measure should not be used, and is not allowed to be used'. To coerce an entire population to use an absolute medical contraindication by force, she said, there had to be definite and serious reasons and the reasons must be presented to competent interdisciplinary and independent bodies to be verified and authorised. She had this warning of the consequences that were coming if mask wearing continued:

When, in ten years, dementia is going to increase exponentially, and the younger generations couldn't reach their god-given potential, it won't help to say 'we didn't need the masks'. I know how damaging oxygen deprivation is for the brain, cardiologists know how damaging it is for the heart, pulmonologists know how damaging it is for the lungs. Oxygen deprivation damages every single organ. Where are our health departments, our health insurance, our medical associations? It would have been their duty to be vehemently against the lockdown and to stop it and stop it from the very beginning.

Why do the medical boards issue punishments to doctors who give people exemptions? Does the person or the doctor seriously have to prove that oxygen deprivation harms people? What kind of medicine are our doctors and medical associations representing? Who is responsible for this crime? The ones who want to enforce it? The ones who let it happen and play along, or the ones who don't prevent it?

All of the organisations and people she mentions there either answer directly to the Cult or do whatever hierarchical levels above them tell them to do. The outcome of both is the same. 'It's not about masks, it's not about viruses, it's certainly not about your health', Griesz-Brisson said. 'It is about much, much more. I am not participating. I am not afraid.' They were taking our air to breathe and there was no unfounded medical exemption from face masks. Oxygen deprivation was dangerous for every single brain. It had to be the free decision of every human being whether they want to

wear a mask that was absolutely ineffective to protect themselves from a virus. She ended by rightly identifying where the responsibility lies for all this:

> The imperative of the hour is personal responsibility. We are responsible for what we think, not the media. We are responsible for what we do, not our superiors. We are responsible for our health, not the World Health Organization. And we are responsible for what happens in our country, not the government.

Halle-bloody-lujah.

But surgeons wear masks, right?

Independent studies of mask-wearing have produced a long list of reports detailing mental, emotional and physical dangers. What a definition of insanity to see police officers imposing mask-wearing on the public which will cumulatively damage their health while the police themselves wear masks that will cumulatively damage *their* health. It's utter madness and both public and police do this because 'the government says so' – yes a government of brain-donor idiots like UK Health Secretary Matt Hancock reading the 'follow the science' scripts of psychopathic, lunatic psychologists. The response you get from Stockholm syndrome sufferers defending the very authorities that are destroying them and their families is that 'surgeons wear masks'. This is considered the game, set and match that they must work and don't cause oxygen deficit. Well, actually, scientific studies have shown that they *do* and oxygen levels are monitored in operating theatres to compensate. Surgeons wear masks to stop spittle and such like dropping into open wounds – not to stop 'viral particles' which are so miniscule they can only be seen through an electron microscope. Holes in the masks are significantly bigger than 'viral particles' and if you sneeze or cough they will breach the mask. I watched an incredibly disingenuous 'experiment' that claimed to prove that masks work in catching 'virus' material from the mouth and nose. They did this with a slow motion camera and the mask did block big stuff which stayed inside the mask and

against the face to be breathed in or cause infections on the face as we have seen with many children. 'Viral particles', however, would never have been picked up by the camera as they came through the mask when they are far too small to be seen. The 'experiment' was therefore disingenuous *and* useless.

Studies have concluded that wearing masks in operating theatres (and thus elsewhere) make no difference to preventing infection while the opposite is true with toxic shite building up in the mask and this had led to an explosion in tooth decay and gum disease dubbed by dentists 'mask mouth'. You might have seen the Internet video of a furious American doctor urging people to take off their masks after a four-year-old patient had been rushed to hospital the night before and nearly died with a lung infection that doctors sourced to mask wearing. A study in the journal *Cancer Discovery* found that inhalation of harmful microbes can contribute to advanced stage lung cancer in adults and long-term use of masks can help breed dangerous pathogens. Microbiologists have said frequent mask wearing creates a moist environment in which microbes can grow and proliferate before entering the lungs. The Canadian Agency for Drugs and Technologies in Health, or CADTH, a Canadian national organisation that provides research and analysis to healthcare decision-makers, said this as long ago as 2013 in a report entitled 'Use of Surgical Masks in the Operating Room: A Review of the Clinical Effectiveness and Guidelines'. It said:

- No evidence was found to support the use of surgical face masks to reduce the frequency of surgical site infections
- No evidence was found on the effectiveness of wearing surgical face masks to protect staff from infectious material in the operating room.
- Guidelines recommend the use of surgical face masks by staff in the operating room to protect both operating room staff and patients (despite the lack of evidence).

We were told that the world could go back to 'normal' with the arrival of the 'vaccines'. When they came, fraudulent as they are, the story changed as I knew that it would. We are in the midst of transforming 'normal', not going back to it. Mary Ramsay, head of immunisation at Public Health England, echoed the words of US criminal Anthony Fauci who said masks and other regulations must stay no matter if people are vaccinated. The Fauci idiot continued to wear two masks – different colours so both could be clearly seen – after he *claimed* to have been vaccinated. Senator Rand Paul told Fauci in one exchange that his double-masks were 'theatre' and he was right. It's all theatre. Mary Ramsay back-tracked on the vaccine-return-to-normal theme when she said the public may need to wear masks and social-distance for years despite the jabs. 'People have got used to those lower-level restrictions now, and [they] can live with them', she said telling us what the idea has been all along. 'The vaccine does not give you a pass, even if you have had it, you must continue to follow all the guidelines' said a Public Health England statement which reneged on what we had been told before and made having the 'vaccine' irrelevant to 'normality' even by the official story. Spain's fascist government trumped everyone by passing a law mandating the wearing of masks on the beach and even when swimming in the sea. The move would have devastated what's left of the Spanish tourist industry, posed potential breathing dangers to swimmers and had Northern European sunbathers walking around with their forehead brown and the rest of their face white as a sheet. The ruling was so crazy that it had to be retracted after pressure from public and tourist industry, but it confirmed where the Cult wants to go with masks and how clinically insane authority has become. The determination to make masks permanent and hide the serious dangers to body and mind can be seen in the censorship of scientist Professor Denis Rancourt by Bill Gates-funded academic publishing website ResearchGate over his papers exposing the dangers and uselessness of masks. Rancourt said:

ResearchGate today has permanently locked my account, which I have had since 2015. Their reasons graphically show the nature of their attack against democracy, and their corruption of

science … By their obscene non-logic, a scientific review of science articles reporting on harms caused by face masks has a 'potential to cause harm'. No criticism of the psychological device (face masks) is tolerated, if the said criticism shows potential to influence public policy.

This is what happens in a fascist world.

Where are the 'greens' (again)?

Other dangers of wearing masks especially regularly relate to the inhalation of minute plastic fibres into the lungs and the deluge of discarded masks in the environment and oceans. Estimates predicted that more than 1.5 billion disposable masks will end up in the world's oceans every year polluting the water with tons of plastic and endangering marine wildlife. Studies project that humans are using 129 billion face masks each month worldwide – about three million a minute. Most are disposable and made from plastic, non-biodegradable microfibers that break down into smaller plastic particles that become widespread in ecosystems. They are littering cities, clogging sewage channels and turning up in bodies of water. I have written in other books about the immense amounts of microplastics from endless sources now being absorbed into the body. Rolf Halden, director of the Arizona State University (ASU) Biodesign Center for Environmental Health Engineering, was the senior researcher in a 2020 study that analysed 47 human tissue samples and found microplastics in all of them. 'We have detected these chemicals of plastics in every single organ that we have investigated', he said. I wrote in *The Answer* about the world being deluged with microplastics. A study by the Worldwide Fund for Nature (WWF) found that people are consuming on average every week some 2,000 tiny pieces of plastic mostly through water and also through marine life and the air. Every year humans are ingesting enough microplastics to fill a heaped dinner plate and in a life-time of 79 years it is enough to fill two large waste bins. Marco Lambertini, WWF International director general said: 'Not only are plastics polluting our oceans and waterways and killing marine life – it's in all of us and we can't escape consuming plastics,' American

geologists found tiny plastic fibres, beads and shards in rainwater samples collected from the remote slopes of the Rocky Mountain National Park near Denver, Colorado. Their report was headed: 'It is raining plastic.' Rachel Adams, senior lecturer in Biomedical Science at Cardiff Metropolitan University, said that among health consequences are internal inflammation and immune responses to a 'foreign body'. She further pointed out that microplastics become carriers of toxins including mercury, pesticides and dioxins (a known cause of cancer and reproductive and developmental problems). These toxins accumulate in the fatty tissues once they enter the body through microplastics. Now this is being compounded massively by people putting plastic on their face and throwing it away.

Workers exposed to polypropylene plastic fibres known as 'flock' have developed 'flock worker's lung' from inhaling small pieces of the flock fibres which can damage lung tissue, reduce breathing capacity and exacerbate other respiratory problems. *Now* … commonly used surgical masks have three layers of melt-blown textiles made of … polypropylene. We have billions of people putting these microplastics against their mouth, nose and face for hours at a time day after day in the form of masks. How does anyone think that will work out? I mean – what could possibly go wrong? We posted a number of scientific studies on this at davidicke.com, but when I went back to them as I was writing this book the links to the science research website where they were hosted were dead. Anything that challenges the official narrative in any way is either censored or vilified. The official narrative is so unsupportable by the evidence that only deleting the truth can protect it. A study by Chinese scientists still survived – with the usual twist which it why it was still active, I guess. Yes, they found that virtually all the masks they tested increased the daily intake of microplastic fibres, but people should still wear them because the danger from the 'virus' was worse said the crazy 'team' from the Institute of Hydrobiology in Wuhan. Scientists first discovered microplastics in lung tissue of some patients who died of lung cancer

in the 1990s. Subsequent studies have confirmed the potential health damage with the plastic degrading slowly and remaining in the lungs to accumulate in volume. Wuhan researchers used a machine simulating human breathing to establish that masks shed up to nearly 4,000 microplastic fibres in a month with reused masks producing more. Scientists said some masks are laced with toxic chemicals and a variety of compounds seriously restricted for both health and environmental reasons. They include cobalt (used in blue dye) and formaldehyde known to cause watery eyes, burning sensations in the eyes, nose, and throat, plus coughing, wheezing and nausea. No – that must be 'Covid-19'.

Mask 'worms'

There is another and potentially even more sinister content of masks. Mostly new masks of different makes filmed under a microscope around the world have been found to contain strange black fibres or 'worms' that appear to move or 'crawl' by themselves and react to heat and water. The nearest I have seen to them are the self-replicating fibres that are pulled out through the skin of those suffering from Morgellons disease which has been connected to the phenomena of 'chemtrails' which I will bring into the story later on. Morgellons fibres continue to grow outside the body and have a form of artificial intelligence. Black 'worm' fibres in masks have that kind of feel to them and there is a nanotechnology technique called 'worm micelles' which carry and release drugs or anything else you want to deliver to the body. For sure the suppression of humanity by mind altering drugs is the Cult agenda big time and the more excuses they can find to gain access to the body the more opportunities there are to make that happen whether through 'vaccines' or masks pushed against the mouth and nose for hours on end.

So let us summarise the pros and cons of masks:

Against masks: Breathing in your own carbon dioxide; depriving the body and brain of sufficient oxygen; build-up of toxins in the mask that can be breathed into the lungs and cause rashes on the face and 'mask-mouth'; breathing microplastic fibres and toxic chemicals into the lungs; dehumanisation and deleting individualisation by literally making people faceless; destroying human emotional interaction through facial expression and deleting parental connection with their babies which look for guidance to their facial expression.

For masks: They don't protect you from a 'virus' that doesn't exist and even if it did 'viral' particles are so minute they are smaller than the holes in the mask.

Governments, police, supermarkets, businesses, transport companies, and all the rest who seek to impose masks have done no risk assessment on their consequences for health and psychology and are now open to group lawsuits when the impact becomes clear with a cumulative epidemic of respiratory and other disease. Authorities will try to exploit these effects and hide the real cause by dubbing them 'Covid-19'. Can you imagine setting out to force the population to wear health-destroying masks without doing any assessment of the risks? It is criminal and it is evil, but then how many people targeted in this way, who see their children told to wear them all day at school, have asked for a risk assessment? Billions can't be imposed upon by the few unless the billions allow it. Oh, yes, with just a tinge of irony, 85 percent of all masks made worldwide come from *China*.

Wash your hands in toxic shite

'Covid' rules include the use of toxic sanitisers and again the health consequences of constantly applying toxins to be absorbed through the skin is obvious to any level of Renegade Mind. America's Food and Drug Administration (FDA) said that sanitisers are drugs and issued a warning about 75 dangerous brands which contain

methanol used in antifreeze and can cause death, kidney damage and blindness. The FDA circulated the following warning even for those brands that it claims to be safe:

Store hand sanitizer out of the reach of pets and children, and children should use it only with adult supervision. Do not drink hand sanitizer. This is particularly important for young children, especially toddlers, who may be attracted by the pleasant smell or brightly colored bottles of hand sanitizer.

Drinking even a small amount of hand sanitizer can cause alcohol poisoning in children. (However, there is no need to be concerned if your children eat with or lick their hands after using hand sanitizer.) During this coronavirus pandemic, poison control centers have had an increase in calls about accidental ingestion of hand sanitizer, so it is important that adults monitor young children's use.

Do not allow pets to swallow hand sanitizer. If you think your pet has eaten something potentially dangerous, call your veterinarian or a pet poison control center right away. Hand sanitizer is flammable and should be stored away from heat and flames. When using hand sanitizer, rub your hands until they feel completely dry before performing activities that may involve heat, sparks, static electricity, or open flames.

There you go, perfectly safe, then, and that's without even a mention of the toxins absorbed through the skin. Come on kids – sanitise your hands everywhere you go. It will save you from the 'virus'. Put all these elements together of the 'Covid' normal and see how much health and psychology is being cumulatively damaged, even devastated, to 'protect your health'. Makes sense, right? They are only imposing these things because they care, right? *Right?*

Submitting to insanity

Psychological reframing of the population goes very deep and is done in many less obvious ways. I hear people say how contradictory and crazy 'Covid' rules are and how they are ever changing. This is explained away by dismissing those involved as idiots. It is a big mistake. The Cult is delighted if its cold calculation is perceived as incompetence and idiocy when it is anything but. Oh, yes, there are idiots within the system – lots of them – but they are *administering* the Cult agenda, mostly unknowingly. They are not deciding and dictating it. The bulwark against tyranny is self-

respect, always has been, always will be. It is self-respect that has broken every tyranny in history. By its very nature self-respect will not bow to oppression and its perpetrators. There is so little self-respect that it's always the few that overturn dictators. Many may eventually follow, but the few with the iron spines (self-respect) kick it off and generate the momentum. The Cult targets self-respect in the knowledge that once this has gone only submission remains. Crazy, contradictory, ever-changing 'Covid' rules are systematically applied by psychologists to delete self-respect. They *want* you to see that the rules make no sense. It is one thing to decide to do something when *you* have made the choice based on evidence and logic. You still retain your self-respect. It is quite another when you can see what you are being told to do is insane, ridiculous and makes no sense, and *yet you still do it*. Your self-respect is extinguished and this has been happening as ever more obviously stupid and nonsensical things have been demanded and the great majority have complied even when they can see they are stupid and nonsensical.

People walk around in face-nappies knowing they are damaging their health and make no difference to a 'virus'. They do it in fear of not doing it. I know it's daft, but I'll do it anyway. When that happens something dies inside of you and submissive reframing has begun. Next there's a need to hide from yourself that you have conceded your self-respect and you convince yourself that you have not really submitted to fear and intimidation. You begin to believe that you are complying with craziness because it's the right thing to do. When first you concede your self-respect of 2+2 = 4 to 2+2 = 5 you *know* you are compromising your self-respect. Gradually to avoid facing that fact you begin to *believe* that 2+2=5. You have been reframed and I have been watching this process happening in the human psyche on an industrial scale. The Cult is working to break your spirit and one of its major tools in that war is humiliation. I read how former American soldier Bradley Manning (later Chelsea Manning after a sex-change) was treated after being jailed for supplying WikiLeaks with documents exposing the enormity of

government and elite mendacity. Manning was isolated in solitary confinement for eight months, put under 24-hour surveillance, forced to hand over clothing before going to bed, and stand naked for every roll call. This is systematic humiliation. The introduction of anal swab 'Covid' tests in China has been done for the same reason to delete self-respect and induce compliant submission. Anal swabs are mandatory for incoming passengers in parts of China and American diplomats have said they were forced to undergo the indignity which would have been calculated humiliation by the Cult-owned Chinese government that has America in its sights.

Government-people: An abusive relationship

Spirit-breaking psychological techniques include giving people hope and apparent respite from tyranny only to take it away again. This happened in the UK during Christmas, 2020, when the psycho-psychologists and their political lackeys announced an easing of restrictions over the holiday only to reimpose them almost immediately on the basis of yet another lie. There is a big psychological difference between getting used to oppression and being given hope of relief only to have that dashed. Psychologists know this and we have seen the technique used repeatedly. Then there is traumatising people before you introduce more extreme regulations that require compliance. A perfect case was the announcement by the dark and sinister Whitty and Vallance in the UK that 'new data' predicted that 4,000 could die every day over the winter of 2020/2021 if we did not lockdown again. I think they call it lying and after traumatising people with that claim out came Jackboot Johnson the next day with new curbs on human freedom. Psychologists know that a frightened and traumatised mind becomes suggestable to submission and behaviour reframing. Underpinning all this has been to make people fearful and suspicious of each other and see themselves as a potential danger to others. In league with deleted self-respect you have the perfect psychological recipe for self-loathing. The relationship between authority and public is now demonstrably the same as that of

subservience to an abusive partner. These are signs of an abusive relationship explained by psychologist Leslie Becker-Phelps:

Psychological and emotional abuse: Undermining a partner's self-worth with verbal attacks, name-calling, and belittling. Humiliating the partner in public, unjustly accusing them of having an affair, or interrogating them about their every behavior. Keeping partner confused or off balance by saying they were just kidding or blaming the partner for 'making' them act this way … Feigning in public that they care while turning against them in private. This leads to victims frequently feeling confused, incompetent, unworthy, hopeless, and chronically self-doubting. [Apply these techniques to how governments have treated the population since New Year, 2020, and the parallels are obvious.]

Physical abuse: The abuser might physically harm their partner in a range of ways, such as grabbing, hitting, punching, or shoving them. They might throw objects at them or harm them with a weapon. [Observe the physical harm imposed by masks, lockdown, and so on.]

Threats and intimidation: One way abusers keep their partners in line is by instilling fear. They might be verbally threatening, or give threatening looks or gestures. Abusers often make it known that they are tracking their partner's every move. They might destroy their partner's possessions, threaten to harm them, or threaten to harm their family members. Not surprisingly, victims of this abuse often feel anxiety, fear, and panic. [No words necessary.]

Isolation: Abusers often limit their partner's activities, forbidding them to talk or interact with friends or family. They might limit access to a car or even turn off their phone. All of this might be done by physically holding them against their will, but is often accomplished through psychological abuse and intimidation. The more isolated a person feels, the fewer resources they have to help gain perspective on their situation and to escape from it. [No words necessary.]

Economic abuse: Abusers often make their partners beholden to them for money by controlling access to funds of any kind. They might prevent their partner from getting a job or withhold access to money they earn from a job. This creates financial dependency that makes leaving the relationship very difficult. [See destruction of livelihoods and the proposed meagre 'guaranteed income' so long as you do whatever you are told.]

Using children: An abuser might disparage their partner's parenting skills, tell their children lies about their partner, threaten to take custody of their children, or threaten to harm their children. These tactics instil fear and often elicit compliance. [See reframed social service mafia and how children are being mercilessly abused by the state over 'Covid' while their parents look on too frightened to do anything.]

A further recurring trait in an abusive relationship is the abused blaming themselves for their abuse and making excuses for the abuser. We have the public blaming each other for lockdown abuse by government and many making excuses for the government while attacking those who challenge the government. How often we have heard authorities say that rules are being imposed or reimposed only because people have refused to 'behave' and follow the rules. We don't want to do it – it's *you*.

Renegade Minds are an antidote to all of these things. They will never concede their self-respect no matter what the circumstances. Even when apparent humiliation is heaped upon them they laugh in its face and reflect back the humiliation on the abuser where it belongs. Renegade Minds will never wear masks they know are only imposed to humiliate, suppress and damage both physically and psychologically. Consequences will take care of themselves and they will never break their spirit or cause them to concede to tyranny. UK newspaper columnist Peter Hitchens was one of the few in the mainstream media to speak out against lockdowns and forced vaccinations. He then announced he had taken the jab. He wanted to see family members abroad and he believed vaccine passports were inevitable even though they had not yet been introduced. Hitchens

has a questioning and critical mind, but not a Renegade one. If he had no amount of pressure would have made him concede. Hitchens excused his action by saying that the battle has been lost. Renegade Minds never accept defeat when freedom is at stake and even if they are the last one standing the self-respect of not submitting to tyranny is more important than any outcome or any consequence.

That's why Renegade Minds are the only minds that ever changed anything worth changing.

CHAPTER EIGHT

'Reframing' insanity

Insanity is relative. It depends on who has who locked in what cage
Ray Bradbury

'Reframing' a mind means simply to change its perception and behaviour. This can be done subconsciously to such an extent that subjects have no idea they have been 'reframed' while to any observer changes in behaviour and attitudes are obvious.

Human society is being reframed on a ginormous scale since the start of 2020 and here we have the reason why psychologists rather than doctors have been calling the shots. Ask most people who have succumbed to 'Covid' reframing if they have changed and most will say 'no'; but they *have* and fundamentally. The Cult's long-game has been preparing for these times since way back and crucial to that has been to prepare both population and officialdom mentally and emotionally. To use the mind-control parlance they had to reframe the population with a mentality that would submit to fascism and reframe those in government and law enforcement to impose fascism or at least go along with it. The result has been the fact-deleted mindlessness of 'Wokeness' and officialdom that has either enthusiastically or unquestioningly imposed global tyranny demanded by reframed politicians on behalf of psychopathic and deeply evil cultists. 'Cognitive reframing' identifies and challenges the way someone sees the world in the form of situations, experiences and emotions and then restructures those perceptions to view the same set of circumstances in a different way. This can have

benefits if the attitudes are personally destructive while on the other side it has the potential for individual and collective mind control which the subject has no idea has even happened.

Cognitive therapy was developed in the 1960s by Aaron T. Beck who was born in Rhode Island in 1921 as the son of Jewish immigrants from the Ukraine. He became interested in the techniques as a treatment for depression. Beck's daughter Judith S. Beck is prominent in the same field and they founded the Beck Institute for Cognitive Behavior Therapy in Philadelphia in 1994. Cognitive reframing, however, began to be used worldwide by those with a very dark agenda. The Cult reframes politicians to change their attitudes and actions until they are completely at odds with what they once appeared to stand for. The same has been happening to government administrators at all levels, law enforcement, military and the human population. Cultists love mind control for two main reasons: It allows them to control what people think, do and say to secure agenda advancement and, by definition, it calms their legendary insecurity and fear of the unexpected. I have studied mind control since the time I travelled America in 1996. I may have been talking to next to no one in terms of an audience in those years, but my goodness did I gather a phenomenal amount of information and knowledge about so many things including the techniques of mind control. I have described this in detail in other books going back to *The Biggest Secret* in 1998. I met a very large number of people recovering from MKUltra and its offshoots and successors and I began to see how these same techniques were being used on the population in general. This was never more obvious than since the 'Covid' hoax began.

Reframing the enforcers

I have observed over the last two decades and more the very clear transformation in the dynamic between the police, officialdom and the public. I tracked this in the books as the relationship mutated from one of serving the public to seeing them as almost the enemy and certainly a lower caste. There has always been a class divide

based on income and always been some psychopathic, corrupt, and big-I-am police officers. This was different. Wholesale change was unfolding in the collective dynamic; it was less about money and far more about position and perceived power. An us-and-them was emerging. Noses were lifted skyward by government administration and law enforcement and their attitude to the public they were *supposed* to be serving changed to one of increasing contempt, superiority and control. The transformation was so clear and widespread that it had to be planned. Collective attitudes and dynamics do not change naturally and organically that quickly on that scale. I then came across an organisation in Britain called Common Purpose created in the late 1980s by Julia Middleton who would work in the office of Deputy Prime Minister John Prescott during the long and disastrous premiership of war criminal Tony Blair. When Blair speaks the Cult is speaking and the man should have been in jail a long time ago. Common Purpose proclaims itself to be one of the biggest 'leadership development' organisations in the world while functioning as a *charity* with all the financial benefits which come from that. It hosts 'leadership development' courses and programmes all over the world and claims to have 'brought together' what it calls 'leaders' from more than 100 countries on six continents. The modus operandi of Common Purpose can be compared with the work of the UK government's reframing network that includes the Behavioural Insights Team 'nudge unit' and 'Covid' reframing specialists at SPI-B. WikiLeaks described Common Purpose long ago as 'a hidden virus in our government and schools' which is unknown to the general public: 'It recruits and trains "leaders" to be loyal to the directives of Common Purpose and the EU, instead of to their own departments, which they then undermine or subvert, the NHS [National Health Service] being an example.' This is a vital point to understand the 'Covid' hoax. The NHS, and its equivalent around the world, has been utterly reframed in terms of administrators and much of the medical personnel with the transformation underpinned by recruitment policies. The outcome has been the criminal and psychopathic behaviour of the

NHS over 'Covid' and we have seen the same in every other major country. WikiLeaks said Common Purpose trainees are 'learning to rule without regard to democracy' and to usher in a police state (current events explained). Common Purpose operated like a 'glue' and had members in the NHS, BBC, police, legal profession, church, many of Britain's 7,000 quangos, local councils, the Civil Service, government ministries and Parliament, and controlled many RDA's (Regional Development Agencies). Here we have one answer for how and why British institutions and their like in other countries have changed so negatively in relation to the public. This further explains how and why the beyond-disgraceful reframed BBC has become a propaganda arm of 'Covid' fascism. They are all part of a network pursuing the same goal.

By 2019 Common Purpose was quoting a figure of 85,000 'leaders' that had attended its programmes. These 'students' of all ages are known as Common Purpose 'graduates' and they consist of government, state and local government officials and administrators, police chiefs and officers, and a whole range of others operating within the national, local and global establishment. Cressida Dick, Commissioner of the London Metropolitan Police, is the Common Purpose graduate who was the 'Gold Commander' that oversaw what can only be described as the murder of Brazilian electrician Jean Charles de Menezes in 2005. He was held down by psychopathic police and shot seven times in the head by a psychopathic lunatic after being mistaken for a terrorist when he was just a bloke going about his day. Dick authorised officers to pursue and keep surveillance on de Menezes and ordered that he be stopped from entering the underground train system. Police psychopaths took her at her word clearly. She was 'disciplined' for this outrage by being *promoted* – eventually to the top of the 'Met' police where she has been a disaster. Many Chief Constables controlling the police in different parts of the UK are and have been Common Purpose graduates. I have heard the 'graduate' network described as a sort of Mafia or secret society operating within the fabric of government at all levels pursuing a collective policy

ingrained at Common Purpose training events. Founder Julia Middleton herself has said:

> Locally and internationally, Common Purpose graduates will be 'lighting small fires' to create change in their organisations and communities … The Common Purpose effect is best illustrated by the many stories of small changes brought about by leaders, who themselves have changed.

A Common Purpose mission statement declared:

> Common Purpose aims to improve the way society works by expanding the vision, decision-making ability and influence of all kinds of leaders. The organisation runs a variety of educational programmes for leaders of all ages, backgrounds and sectors, in order to provide them with the inspirational, information and opportunities they need to change the world.

Yes, but into what? Since 2020 the answer has become clear.

NLP and the Delphi technique

Common Purpose would seem to be a perfect name or would common programming be better? One of the foundation methods of reaching 'consensus' (group think) is by setting the agenda theme and then encouraging, cajoling or pressuring everyone to agree a 'consensus' in line with the core theme promoted by Common Purpose. The methodology involves the 'Delphi technique', or an adaption of it, in which opinions are expressed that are summarised by a 'facilitator or change agent' at each stage. Participants are 'encouraged' to modify their views in the light of what others have said. Stage by stage the former individual opinions are merged into group consensus which just happens to be what Common Purpose wants them to believe. A key part of this is to marginalise anyone refusing to concede to group think and turn the group against them to apply pressure to conform. We are seeing this very technique used on the general population to make 'Covid' group-thinkers hostile to those who have seen through the bullshit. People can be reframed by using perception manipulation methods such as Neuro-Linguistic Programming (NLP) in which you change perception with the use of

carefully constructed language. An NLP website described the technique this way:

… A method of influencing brain behaviour (the 'neuro' part of the phrase) through the use of language (the 'linguistic' part) and other types of communication to enable a person to 'recode' the way the brain responds to stimuli (that's the 'programming') and manifest new and better behaviours. Neuro-Linguistic Programming often incorporates hypnosis and self-hypnosis to help achieve the change (or 'programming') that is wanted.

British alternative media operation UKColumn has done very detailed research into Common Purpose over a long period. I quoted co-founder and former naval officer Brian Gerrish in my book *Remember Who You Are*, published in 2011, as saying the following years before current times:

It is interesting that many of the mothers who have had children taken by the State speak of the Social Services people being icily cool, emotionless and, as two ladies said in slightly different words, '… like little robots'. We know that NLP is cumulative, so people can be given small imperceptible doses of NLP in a course here, another in a few months, next year etc. In this way, major changes are accrued in their personality, but the day by day change is almost unnoticeable.

In these and other ways 'graduates' have had their perceptions uniformly reframed and they return to their roles in the institutions of government, law enforcement, legal profession, military, 'education', the UK National Health Service and the whole swathe of the establishment structure to pursue a common agenda preparing for the 'post-industrial', 'post-democratic' society. I say 'preparing' but we are now there. 'Post-industrial' is code for the Great Reset and 'post-democratic' is 'Covid' fascism. UKColumn has spoken to partners of those who have attended Common Purpose 'training'. They have described how personalities and attitudes of 'graduates' changed very noticeably for the worse by the time they had completed the course. They had been 'reframed' and told they are the 'leaders' – the special ones – who know better than the population. There has also been the very demonstrable recruitment of psychopaths and narcissists into government administration at all

levels and law enforcement. If you want psychopathy hire psychopaths and you get a simple cause and effect. If you want administrators, police officers and 'leaders' to perceive the public as lesser beings who don't matter then employ narcissists. These personalities are identified using 'psychometrics' that identifies knowledge, abilities, attitudes and personality traits, mostly through carefully-designed questionnaires and tests. As this policy has passed through the decades we have had power-crazy, power-trippers appointed into law enforcement, security and government administration in preparation for current times and the dynamic between public and law enforcement/officialdom has been transformed. UKColumn's Brian Gerrish said of the narcissistic personality:

> Their love of themselves and power automatically means that they will crush others who get in their way. I received a major piece of the puzzle when a friend pointed out that when they made public officials re-apply for their own jobs several years ago they were also required to do psychometric tests. This was undoubtedly the start of the screening process to get 'their' sort of people in post.

How obvious that has been since 2020 although it was clear what was happening long before if people paid attention to the changing public-establishment dynamic.

Change agents

At the centre of events in 'Covid' Britain is the National Health Service (NHS) which has behaved disgracefully in slavishly following the Cult agenda. The NHS management structure is awash with Common Purpose graduates or 'change agents' working to a common cause. Helen Bevan, a Chief of Service Transformation at the NHS Institute for Innovation and Improvement, co-authored a document called 'Towards a million change agents, a review of the social movements literature: implications for large scale change in the NHS'. The document compared a project management approach to that of change and social movements where 'people change

themselves and each other – peer to peer'. Two definitions given for a 'social movement' were:

A group of people who consciously attempt to build a radically new social order; involves people of a broad range of social backgrounds; and deploys politically confrontational and socially disruptive tactics – Cyrus Zirakzadeh 1997

Collective challenges, based on common purposes and social solidarities, in sustained interaction with elites, opponents, and authorities – Sidney Tarrow 1994

Helen Bevan wrote another NHS document in which she defined 'framing' as 'the process by which leaders construct, articulate and put across their message in a powerful and compelling way in order to win people to their cause and call them to action'. I think I could come up with another definition that would be rather more accurate. The National Health Service and institutions of Britain and the wider world have been taken over by reframed 'change agents' and that includes everything from the United Nations to national governments, local councils and social services which have been kidnapping children from loving parents on an extraordinary and gathering scale on the road to the end of parenthood altogether. Children from loving homes are stolen and kidnapped by the state and put into the 'care' (inversion) of the local authority through council homes, foster parents and forced adoption. At the same time children are allowed to be abused without response while many are under council 'care'. UKColumn highlighted the Common Purpose connection between South Yorkshire Police and Rotherham council officers in the case of the scandal in that area of the sexual exploitation of children to which the authorities turned not one blind eye, but both:

We were alarmed to discover that the Chief Executive, the Strategic Director of Children and Young People's Services, the Manager for the Local Strategic Partnership, the Community Cohesion Manager, the Cabinet Member for Cohesion, the Chief Constable and his predecessor had all attended Leadership training courses provided by the pseudo-charity Common Purpose.

Once 'change agents' have secured positions of hire and fire within any organisation things start to move very quickly. Personnel are then hired and fired on the basis of whether they will work towards the agenda the change agent represents. If they do they are rapidly promoted even though they may be incompetent. Those more qualified and skilled who are pre-Common Purpose 'old school' see their careers stall and even disappear. This has been happening for decades in every institution of state, police, 'health' and social services and all of them have been transformed as a result in their attitudes to their jobs and the public. Medical professions, including nursing, which were once vocations for the caring now employ many cold, callous and couldn't give a shit personality types. The UKColumn investigation concluded:

By blurring the boundaries between people, professions, public and private sectors, responsibility and accountability, Common Purpose encourages 'graduates' to believe that as new selected leaders, they can work together, outside of the established political and social structures, to achieve a paradigm shift or CHANGE – so called 'Leading Beyond Authority'. In doing so, the allegiance of the individual becomes 'reframed' on CP colleagues and their NETWORK.

Reframing the Face-Nappies

Nowhere has this process been more obvious than in the police where recruitment of psychopaths and development of unquestioning mind-controlled group-thinkers have transformed law enforcement into a politically-correct 'Woke' joke and a travesty of what should be public service. Today they wear their face-nappies like good little gofers and enforce 'Covid' rules which are fascism under another name. Alongside the specifically-recruited psychopaths we have software minds incapable of free thought. Brian Gerrish again:

An example is the policeman who would not get on a bike for a press photo because he had not done the cycling proficiency course. Normal people say this is political correctness gone mad. Nothing could be further from the truth. The policeman has been reframed, and in his reality it is perfect common sense not to get on the bike 'because he hasn't done the cycling course'.

Another example of this is where the police would not rescue a boy from a pond until they had taken advice from above on the 'risk assessment'. A normal person would have arrived, perhaps thought of the risk for a moment, and dived in. To the police now 'reframed', they followed 'normal' procedure.

There are shocking cases of reframed ambulance crews doing the same. Sheer unthinking stupidity of London Face-Nappies headed by Common Purpose graduate Cressida Dick can be seen in their behaviour at a vigil in March, 2021, for a murdered woman, Sarah Everard. A police officer had been charged with the crime. Anyone with a brain would have left the vigil alone in the circumstances. Instead they 'manhandled' women to stop them breaking 'Covid rules' to betray classic reframing. Minds in the thrall of perception control have no capacity for seeing a situation on its merits and acting accordingly. 'Rules is rules' is their only mind-set. My father used to say that rules and regulations are for the guidance of the intelligent and the blind obedience of the idiot. Most of the intelligent, decent, coppers have gone leaving only the other kind and a few old school for whom the job must be a daily nightmare. The combination of psychopaths and rule-book software minds has been clearly on public display in the 'Covid' era with automaton robots in uniform imposing fascistic 'Covid' regulations on the population without any personal initiative or judging situations on their merits. There are thousands of examples around the world, but I'll make my point with the infamous Derbyshire police in the English East Midlands – the ones who think pouring dye into beauty spots and using drones to track people walking in the countryside away from anyone is called 'policing'. To them there are rules decreed by the government which they have to enforce and in their bewildered state a group gathering in a closed space and someone walking alone in the countryside are the same thing. It is beyond idiocy and enters the realm of clinical insanity.

Police officers in Derbyshire said they were 'horrified' – *horrified* – to find 15 to 20 'irresponsible' kids playing a football match at a closed leisure centre 'in breach of coronavirus restrictions'. When they saw the police the kids ran away leaving their belongings behind and the reframed men and women of Derbyshire police were seeking to establish their identities with a view to fining their parents. The most natural thing for youngsters to do – kicking a ball about – is turned into a criminal activity and enforced by the moronic software programs of Derbyshire police. You find the same mentality in every country. These barely conscious 'horrified' officers said they had to take action because 'we need to ensure these rules are being followed' and 'it is of the utmost importance that you ensure your children are following the rules and regulations for Covid-19'. Had any of them done ten seconds of research to see if this parroting of their masters' script could be supported by any evidence? Nope. Reframed people don't think – others think for them and that's the whole idea of reframing. I have seen police officers one after the other repeating without question word for word what officialdom tells them just as I have seen great swathes of the public doing the same. Ask either for 'their' opinion and out spews what they have been told to think by the official narrative. Police and public may seem to be in different groups, but their mentality is the same. Most people do whatever they are told in fear not doing so or because they believe what officialdom tells them; almost the entirety of the police do what they are told for the same reason. Ultimately it's the tiny inner core of the global Cult that's telling both what to do.

So Derbyshire police were 'horrified'. Oh, really? Why did they think those kids were playing football? It was to relieve the psychological consequences of lockdown and being denied human contact with their friends and interaction, touch and discourse vital to human psychological health. Being denied this month after month has dismantled the psyche of many children and young people as depression and suicide have exploded. Were Derbyshire police *horrified by that*? Are you kidding? Reframed people don't have those

mental and emotional processes that can see how the impact on the psychological health of youngsters is far more dangerous than any 'virus' even if you take the mendacious official figures to be true. The reframed are told (programmed) how to act and so they do. The Derbyshire Chief Constable in the first period of lockdown when the black dye and drones nonsense was going on was Peter Goodman. He was the man who severed the connection between his force and the Derbyshire Constabulary *Male Voice* Choir when he decided that it was not inclusive enough to allow women to join. The fact it was a male voice choir making a particular sound produced by male voices seemed to elude a guy who terrifyingly ran policing in Derbyshire. He retired weeks after his force was condemned as disgraceful by former Supreme Court Justice Jonathan Sumption for their behaviour over extreme lockdown impositions. Goodman was replaced by his deputy Rachel Swann who was in charge when her officers were 'horrified'. The police statement over the boys committing the hanging-offence of playing football included the line about the youngsters being 'irresponsible in the times we are all living through' missing the point that the real relevance of the 'times we are all living through' is the imposition of fascism enforced by psychopaths and reframed minds of police officers playing such a vital part in establishing the fascist tyranny that their own children and grandchildren will have to live in their entire lives. As a definition of insanity that is hard to beat although it might be run close by imposing masks on people that can have a serious effect on their health while wearing a face nappy all day themselves. Once again public and police do it for the same reason – the authorities tell them to and who are they to have the self-respect to say no?

Wokers in uniform

How reframed do you have to be to arrest a *six-year-old* and take him to court for *picking a flower* while waiting for a bus? Brain dead police and officialdom did just that in North Carolina where criminal proceedings happen regularly for children under nine. Attorney Julie Boyer gave the six-year-old crayons and a colouring book

during the 'flower' hearing while the 'adults' decided his fate. County Chief District Court Judge Jay Corpening asked: 'Should a child that believes in Santa Claus, the Easter Bunny and the tooth fairy be making life-altering decisions?' Well, of course not, but common sense has no meaning when you have a common purpose and a reframed mind. Treating children in this way, and police operating in American schools, is all part of the psychological preparation for children to accept a police state as normal all their adult lives. The same goes for all the cameras and biometric tracking technology in schools. Police training is focused on reframing them as snowflake Wokers and this is happening in the military. Pentagon top brass said that 'training sessions on extremism' were needed for troops who asked why they were so focused on the Capitol Building riot when Black Lives Matter riots were ignored. What's the difference between them some apparently and rightly asked. Actually, there is a difference. Five people died in the Capitol riot, only one through violence, and that was a police officer shooting an unarmed protestor. BLM riots killed at least 25 people and cost billions. Asking the question prompted the psychopaths and reframed minds that run the Pentagon to say that more 'education' (programming) was needed. Troop training is all based on psychological programming to make them fodder for the Cult – 'Military men are just dumb, stupid animals to be used as pawns in foreign policy' as Cult-to-his-DNA former Secretary of State Henry Kissinger famously said. Governments see the police in similar terms and it's time for those among them who can see this to defend the people and stop being enforcers of the Cult agenda upon the people.

The US military, like the country itself, is being targeted for destruction through a long list of Woke impositions. Cult-owned gaga 'President' Biden signed an executive order when he took office to allow taxpayer money to pay for transgender surgery for active military personnel and veterans. Are you a man soldier? No, I'm a LGBTQIA+ with a hint of Skoliosexual and Spectrasexual. Oh, good man. Bad choice of words you bigot. The Pentagon announced in March, 2021, the appointment of the first 'diversity and inclusion

officer' for US Special Forces. Richard Torres-Estrada arrived with the publication of a 'D&I Strategic Plan which will guide the enterprise-wide effort to institutionalize and sustain D&I'. If you think a Special Forces 'Strategic Plan' should have something to do with defending America you haven't been paying attention. Defending Woke is now the military's new role. Torres-Estrada has posted images comparing Donald Trump with Adolf Hitler and we can expect no bias from him as a representative of the supposedly non-political Pentagon. Cable news host Tucker Carlson said: 'The Pentagon is now the Yale faculty lounge but with cruise missiles.' Meanwhile Secretary of Defense Lloyd Austin, a board member of weapons-maker Raytheon with stock and compensation interests in October, 2020, worth $1.4 million, said he was purging the military of the 'enemy within' – anyone who isn't Woke and supports Donald Trump. Austin refers to his targets as 'racist extremists' while in true Woke fashion being himself a racist extremist. Pentagon documents pledge to 'eradicate, eliminate and conquer all forms of racism, sexism and homophobia'. The definitions of these are decided by 'diversity and inclusion committees' peopled by those who see racism, sexism and homophobia in every situation and opinion. Woke (the Cult) is dismantling the US military and purging testosterone as China expands its military and gives its troops 'masculinity training'. How do we think that is going to end when this is all Cult coordinated? The US military, like the British military, is controlled by Woke and spineless top brass who just go along with it out of personal career interests.

'Woke' means fast asleep

Mind control and perception manipulation techniques used on individuals to create group-think have been unleashed on the global population in general. As a result many have no capacity to see the obvious fascist agenda being installed all around them or what 'Covid' is really all about. Their brains are firewalled like a computer system not to process certain concepts, thoughts and realisations that are bad for the Cult. The young are most targeted as the adults they

will be when the whole fascist global state is planned to be fully implemented. They need to be prepared for total compliance to eliminate all pushback from entire generations. The Cult has been pouring billions into taking complete control of 'education' from schools to universities via its operatives and corporations and not least Bill Gates as always. The plan has been to transform 'education' institutions into programming centres for the mentality of 'Woke'. James McConnell, professor of psychology at the University of Michigan, wrote in *Psychology Today* in 1970:

> The day has come when we can combine sensory deprivation with drugs, hypnosis, and astute manipulation of reward and punishment, to gain almost absolute control over an individual's behaviour. It should then be possible to achieve a very rapid and highly effective type of brainwashing that would allow us to make dramatic changes in a person's behaviour and personality ...
>
> … We should reshape society so that we all would be trained from birth to want to do what society wants us to do. We have the techniques to do it... no-one owns his own personality you acquired, and there's no reason to believe you should have the right to refuse to acquire a new personality if your old one is anti-social.

This was the potential for mass brainwashing in 1970 and the mentality there displayed captures the arrogant psychopathy that drives it forward. I emphasise that not all young people have succumbed to Woke programming and those that haven't are incredibly impressive people given that today's young are the most perceptually-targeted generations in history with all the technology now involved. Vast swathes of the young generations, however, have fallen into the spell – and that's what it is – of Woke. The Woke mentality and perceptual program is founded on *inversion* and you will appreciate later why that is so significant. Everything with Woke is inverted and the opposite of what it is claimed to be. Woke was a term used in African-American culture from the 1900s and referred to an awareness of social and racial justice. This is not the meaning of the modern version or 'New Woke' as I call it in *The Answer*. Oh, no, Woke today means something very different no matter how much Wokers may seek to hide that and insist Old Woke and New

Woke are the same. See if you find any 'awareness of social justice' here in the modern variety:

- Woke demands 'inclusivity' while excluding anyone with a different opinion and calls for mass censorship to silence other views.

- Woke claims to stand against oppression when imposing oppression is the foundation of all that it does. It is the driver of political correctness which is nothing more than a Cult invention to manipulate the population to silence itself.

- Woke believes itself to be 'liberal' while pursuing a global society that can only be described as fascist (see 'anti-fascist' fascist Antifa).

- Woke calls for 'social justice' while spreading injustice wherever it goes against the common 'enemy' which can be easily identified as a differing view.

- Woke is supposed to be a metaphor for 'awake' when it is solid-gold asleep and deep in a Cult-induced coma that meets the criteria for 'off with the fairies'.

I state these points as obvious facts if people only care to look. I don't do this with a sense of condemnation. We need to appreciate that the onslaught of perceptual programming on the young has been incessant and merciless. I can understand why so many have been reframed, or, given their youth, framed from the start to see the world as the Cult demands. The Cult has had access to their minds day after day in its 'education' system for their entire formative years. Perception is formed from information received and the Cult-created system is a life-long download of information delivered to elicit a particular perception, thus behaviour. The more this has expanded into still new extremes in recent decades and ever-increasing censorship has deleted other opinions and information why wouldn't that lead to a perceptual reframing on a mass scale? I

have described already cradle-to-grave programming and in more recent times the targeting of young minds from birth to adulthood has entered the stratosphere. This has taken the form of skewing what is 'taught' to fit the Cult agenda and the omnipresent techniques of group-think to isolate non-believers and pressure them into line. There has always been a tendency to follow the herd, but we really are in a new world now in relation to that. We have parents who can see the 'Covid' hoax told by their children not to stop them wearing masks at school, being 'Covid' tested or having the 'vaccine' in fear of the peer-pressure consequences of being different. What is 'peer-pressure' if not pressure to conform to group-think? Renegade Minds never group-think and always retain a set of perceptions that are unique to them. Group-think is always underpinned by consequences for not group-thinking. Abuse now aimed at those refusing DNA-manipulating 'Covid vaccines' are a potent example of this. The biggest pressure to conform comes from the very group which is itself being manipulated. 'I am programmed to be part of a hive mind and so you must be.'

Woke control structures in 'education' now apply to every mainstream organisation. Those at the top of the 'education' hierarchy (the Cult) decide the policy. This is imposed on governments through the Cult network; governments impose it on schools, colleges and universities; their leadership impose the policy on teachers and academics and they impose it on children and students. At any level where there is resistance, perhaps from a teacher or university lecturer, they are targeted by the authorities and often fired. Students themselves regularly demand the dismissal of academics (increasingly few) at odds with the narrative that the students have been programmed to believe in. It is quite a thought that students who are being targeted by the Cult become so consumed by programmed group-think that they launch protests and demand the removal of those who are trying to push back against those targeting the students. Such is the scale of perceptual inversion. We see this with 'Covid' programming as the Cult imposes the rules via psycho-psychologists and governments on

shops, transport companies and businesses which impose them on their staff who impose them on their customers who pressure Pushbackers to conform to the will of the Cult which is in the process of destroying them and their families. Scan all aspects of society and you will see the same sequence every time.

Fact free Woke and hijacking the 'left'

There is no more potent example of this than 'Woke', a mentality only made possible by the deletion of factual evidence by an 'education' system seeking to produce an ever more uniform society. Why would you bother with facts when you don't know any? Deletion of credible history both in volume and type is highly relevant. Orwell said: 'Who controls the past controls the future: who controls the present controls the past.' They who control the perception of the past control the perception of the future and they who control the present control the perception of the past through the writing and deleting of history. Why would you oppose the imposition of Marxism in the name of Wokeism when you don't know that Marxism cost at least 100 million lives in the 20th century alone? Watch videos and read reports in which Woker generations are asked basic historical questions – it's mind-blowing. A survey of 2,000 people found that six percent of millennials (born approximately early1980s to early 2000s) believed the Second World War (1939-1945) broke out with the assassination of President Kennedy (in 1963) and one in ten thought Margaret Thatcher was British Prime Minister at the time. She was in office between 1979 and 1990. We are in a post-fact society. Provable facts are no defence against the fascism of political correctness or Silicon Valley censorship. Facts don't matter anymore as we have witnessed with the 'Covid' hoax. Sacrificing uniqueness to the Woke group-think religion is all you are required to do and that means thinking for yourself is the biggest Woke no, no. All religions are an expression of group-think and censorship and Woke is just another religion with an orthodoxy defended by group-think and censorship. Burned at

the stake becomes burned on Twitter which leads back eventually to burned at the stake as Woke humanity regresses to ages past.

The biggest Woke inversion of all is its creators and funders. I grew up in a traditional left of centre political household on a council estate in Leicester in the 1950s and 60s – you know, the left that challenged the power of wealth-hoarding elites and threats to freedom of speech and opinion. In those days students went on marches defending freedom of speech while today's Wokers march for its deletion. What on earth could have happened? Those very elites (collectively the Cult) that we opposed in my youth and early life have funded into existence the antithesis of that former left and hijacked the 'brand' while inverting everything it ever stood for. We have a mentality that calls itself 'liberal' and 'progressive' while acting like fascists. Cult billionaires and their corporations have funded themselves into control of 'education' to ensure that Woke programming is unceasing throughout the formative years of children and young people and that non-Wokers are isolated (that word again) whether they be students, teachers or college professors. The Cult has funded into existence the now colossal global network of Woke organisations that have spawned and promoted all the 'causes' on the Cult wish-list for global transformation and turned Wokers into demanders of them. Does anyone really think it's a coincidence that the Cult agenda for humanity is a carbon (sorry) copy of the societal transformations desired by Woke?? These are only some of them:

Political correctness: The means by which the Cult deletes all public debates that it knows it cannot win if we had the free-flow of information and evidence.

Human-caused 'climate change': The means by which the Cult seeks to transform society into a globally-controlled dictatorship imposing its will over the fine detail of everyone's lives 'to save the planet' which doesn't actually need saving.

Transgender obsession: Preparing collective perception to accept the 'new human' which would not have genders because it would be created technologically and not through procreation. I'll have much more on this in Human 2.0.

Race obsession: The means by which the Cult seeks to divide and rule the population by triggering racial division through the perception that society is more racist than ever when the opposite is the case. Is it perfect in that regard? No. But to compare today with the racism of apartheid and segregation brought to an end by the civil rights movement in the 1960s is to insult the memory of that movement and inspirations like Martin Luther King. Why is the 'anti-racism' industry (which it is) so dominated by privileged white people?

White supremacy: This is a label used by privileged white people to demonise poor and deprived white people pushing back on tyranny to marginalise and destroy them. White people are being especially targeted as the dominant race by number within Western society which the Cult seeks to transform in its image. If you want to change a society you must weaken and undermine its biggest group and once you have done that by using the other groups you next turn on them to do the same … 'Then they came for the Jews and I was not a Jew so I did nothing.'

Mass migration: The mass movement of people from the Middle East, Africa and Asia into Europe, from the south into the United States and from Asia into Australia are another way the Cult seeks to dilute the racial, cultural and political influence of white people on Western society. White people ask why their governments appear to be working against them while being politically and culturally biased towards incoming cultures. Well, here's your answer. In the same way sexually 'straight' people, men and women, ask why the

authorities are biased against them in favour of other sexualities. The answer is the same – that's the way the Cult wants it to be for very sinister motives.

These are all central parts of the Cult agenda and central parts of the Woke agenda and Woke was created and continues to be funded to an immense degree by Cult billionaires and corporations. If anyone begins to say 'coincidence' the syllables should stick in their throat.

Billionaire 'social justice warriors'

Joe Biden is a 100 percent-owned asset of the Cult and the Wokers' man in the White House whenever he can remember his name and for however long he lasts with his rapidly diminishing cognitive function. Even walking up the steps of an aircraft without falling on his arse would appear to be a challenge. He's not an empty-shell puppet or anything. From the minute Biden took office (or the Cult did) he began his executive orders promoting the Woke wish-list. You will see the Woke agenda imposed ever more severely because it's really the *Cult* agenda. Woke organisations and activist networks spawned by the Cult are funded to the extreme so long as they promote what the Cult wants to happen. Woke is funded to promote 'social justice' by billionaires who become billionaires by destroying social justice. The social justice mantra is only a cover for dismantling social justice and funded by billionaires that couldn't give a damn about social justice. Everything makes sense when you see that. One of Woke's premier funders is Cult billionaire financier George Soros who said: 'I am basically there to make money, I cannot and do not look at the social consequences of what I do.' This is the same Soros who has given more than $32 billion to his Open Society Foundations global Woke network and funded Black Lives Matter, mass immigration into Europe and the United States, transgender activism, climate change activism, political correctness and groups targeting 'white supremacy' in the form of privileged white thugs that dominate Antifa. What a scam it all is and when

you are dealing with the unquestioning fact-free zone of Woke scamming them is child's play. All you need to pull it off in all these organisations are a few in-the-know agents of the Cult and an army of naïve, reframed, uninformed, narcissistic, know-nothings convinced of their own self-righteousness, self-purity and virtue.

Soros and fellow billionaires and billionaire corporations have poured hundreds of millions into Black Lives Matter and connected groups and promoted them to a global audience. None of this is motivated by caring about black people. These are the billionaires that have controlled and exploited a system that leaves millions of black people in abject poverty and deprivation which they do absolutely nothing to address. The same Cult networks funding BLM were behind the *slave trade!* Black Lives Matter hijacked a phrase that few would challenge and they have turned this laudable concept into a political weapon to divide society. You know that BLM is a fraud when it claims that *All* Lives Matter, the most inclusive statement of all, is 'racist'. BLM and its Cult masters don't want to end racism. To them it's a means to an end to control all of humanity never mind the colour, creed, culture or background. What has destroying the nuclear family got to do with ending racism? Nothing – but that is one of the goals of BLM and also happens to be a goal of the Cult as I have been exposing in my books for decades. Stealing children from loving parents and giving schools ever more power to override parents is part of that same agenda. BLM is a Marxist organisation and why would that not be the case when the Cult created Marxism *and* BLM? Patrisse Cullors, a BLM co-founder, said in a 2015 video that she and her fellow organisers, including co-founder Alicia Garza, are 'trained Marxists'. The lady known after marriage as Patrisse Khan-Cullors bought a $1.4 million home in 2021 in one of the whitest areas of California with a black population of just 1.6 per cent and has so far bought *four* high-end homes for a total of $3.2 million. How very Marxist. There must be a bit of spare in the BLM coffers, however, when Cult corporations and billionaires have handed over the best part of $100 million. Many black people can see that Black Lives Matter is not

working for them, but against them, and this is still more confirmation. Black journalist Jason Whitlock, who had his account suspended by Twitter for simply linking to the story about the 'Marxist's' home buying spree, said that BLM leaders are 'making millions of dollars off the backs of these dead black men who they wouldn't spit on if they were on fire and alive'.

Black Lies Matter

Cult assets and agencies came together to promote BLM in the wake of the death of career criminal George Floyd who had been jailed a number of times including for forcing his way into the home of a black woman with others in a raid in which a gun was pointed at her stomach. Floyd was filmed being held in a Minneapolis street in 2020 with the knee of a police officer on his neck and he subsequently died. It was an appalling thing for the officer to do, but the same technique has been used by police on peaceful protestors of lockdown without any outcry from the Woke brigade. As unquestioning supporters of the Cult agenda Wokers have supported lockdown and all the 'Covid' claptrap while attacking anyone standing up to the tyranny imposed in its name. Court documents would later include details of an autopsy on Floyd by County Medical Examiner Dr Andrew Baker who concluded that Floyd had taken a fatal level of the drug fentanyl. None of this mattered to fact-free, question-free, Woke. Floyd's death was followed by worldwide protests against police brutality amid calls to defund the police. Throwing babies out with the bathwater is a Woke speciality. In the wake of the murder of British woman Sarah Everard a Green Party member of the House of Lords, Baroness Jones of Moulescoomb (Nincompoopia would have been better), called for a 6pm curfew for all men. This would be in breach of the Geneva Conventions on war crimes which ban collective punishment, but that would never have crossed the black and white Woke mind of Baroness Nincompoopia who would have been far too convinced of her own self-righteousness to compute such details. Many American cities did defund the police in the face of Floyd riots

and after $15 million was deleted from the police budget in Washington DC under useless Woke mayor Muriel Bowser car-jacking alone rose by 300 percent and within six months the US capital recorded its highest murder rate in 15 years. The same happened in Chicago and other cities in line with the Cult/Soros plan to bring fear to streets and neighbourhoods by reducing the police, releasing violent criminals and not prosecuting crime. This is the mob-rule agenda that I have warned in the books was coming for so long. Shootings in the area of Minneapolis where Floyd was arrested increased by 2,500 percent compared with the year before. Defunding the police over George Floyd has led to a big increase in dead people with many of them black. Police protection for politicians making these decisions stayed the same or increased as you would expect from professional hypocrites. The Cult doesn't actually want to abolish the police. It wants to abolish local control over the police and hand it to federal government as the psychopaths advance the Hunger Games Society. Many George Floyd protests turned into violent riots with black stores and businesses destroyed by fire and looting across America fuelled by Black Lives Matter. Woke doesn't do irony. If you want civil rights you must loot the liquor store and the supermarket and make off with a smart TV. It's the only way.

It's not a race war – it's a class war

Black people are patronised by privileged blacks and whites alike and told they are victims of white supremacy. I find it extraordinary to watch privileged blacks supporting the very system and bloodline networks behind the slave trade and parroting the same Cult-serving manipulative crap of their privileged white, often billionaire, associates. It is indeed not a race war but a class war and colour is just a diversion. Black Senator Cory Booker and black Congresswoman Maxine Waters, more residents of Nincompoopia, personify this. Once you tell people they are victims of someone else you devalue both their own responsibility for their plight and the power they have to impact on their reality and experience. Instead

we have: 'You are only in your situation because of whitey – turn on them and everything will change.' It won't change. Nothing changes in our lives unless *we* change it. Crucial to that is never seeing yourself as a victim and always as the creator of your reality. Life is a simple sequence of choice and consequence. Make different choices and you create different consequences. *You* have to make those choices – not Black Lives Matter, the Woke Mafia and anyone else that seeks to dictate your life. Who are they these Wokers, an emotional and psychological road traffic accident, to tell you what to do? Personal empowerment is the last thing the Cult and its Black Lives Matter want black people or anyone else to have. They claim to be defending the underdog while *creating* and perpetuating the underdog. The Cult's worst nightmare is human unity and if they are going to keep blacks, whites and every other race under economic servitude and control then the focus must be diverted from what they have in common to what they can be manipulated to believe divides them. Blacks have to be told that their poverty and plight is the fault of the white bloke living on the street in the same poverty and with the same plight they are experiencing. The difference is that your plight black people is due to him, a white supremacist with 'white privilege' living on the street. Don't unite as one human family against your mutual oppressors and suppressors – fight the oppressor with the white face who is as financially deprived as you are. The Cult knows that as its 'Covid' agenda moves into still new levels of extremism people are going to respond and it has been spreading the seeds of disunity everywhere to stop a united response to the evil that targets *all of us*.

Racist attacks on 'whiteness' are getting ever more outrageous and especially through the American Democratic Party which has an appalling history for anti-black racism. Barack Obama, Joe Biden, Hillary Clinton and Nancy Pelosi all eulogised about Senator Robert Byrd at his funeral in 2010 after a nearly 60-year career in Congress. Byrd was a brutal Ku Klux Klan racist and a violent abuser of Cathy O'Brien in MKUltra. He said he would never fight in the military 'with a negro by my side' and 'rather I should die a thousand times,

and see Old Glory trampled in the dirt never to rise again, than to see this beloved land of ours become degraded by race mongrels, a throwback to the blackest specimen from the wilds'. Biden called Byrd a 'very close friend and mentor'. These 'Woke' hypocrites are not anti-racist they are anti-poor and anti-people not of their perceived class. Here is an illustration of the scale of anti-white racism to which we have now descended. Seriously Woke and moronic *New York Times* contributor Damon Young described whiteness as a 'virus' that 'like other viruses will not die until there are no bodies left for it to infect'. He went on: '… the only way to stop it is to locate it, isolate it, extract it, and kill it.' Young can say that as a black man with no consequences when a white man saying the same in reverse would be facing a jail sentence. *That's* racism. We had super-Woke numbskull senators Tammy Duckworth and Mazie Hirono saying they would object to future Biden Cabinet appointments if he did not nominate more Asian Americans and Pacific Islanders. Never mind the ability of the candidate what do they look like? Duckworth said: 'I will vote for racial minorities and I will vote for LGBTQ, but anyone else I'm not voting for.' Appointing people on the grounds of race is illegal, but that was not a problem for this ludicrous pair. They were on-message and that's a free pass in any situation.

Critical race racism

White children are told at school they are intrinsically racist as they are taught the divisive 'critical race theory'. This claims that the law and legal institutions are inherently racist and that race is a socially constructed concept used by white people to further their economic and political interests at the expense of people of colour. White is a 'virus' as we've seen. Racial inequality results from 'social, economic, and legal differences that white people create between races to maintain white interests which leads to poverty and criminality in minority communities'. I must tell that to the white guy sleeping on the street. The principal of East Side Community School in New York sent white parents a manifesto that called on

them to become 'white traitors' and advocate for full 'white abolition'. These people are teaching your kids when they urgently need a psychiatrist. The 'school' included a chart with 'eight white identities' that ranged from 'white supremacist' to 'white abolition' and defined the behaviour white people must follow to end 'the regime of whiteness'. Woke blacks and their privileged white associates are acting exactly like the slave owners of old and Ku Klux Klan racists like Robert Byrd. They are too full of their own self-purity to see that, but it's true. Racism is not a body type; it's a state of mind that can manifest through any colour, creed or culture.

Another racial fraud is *'equity'*. Not equality of treatment and opportunity – equity. It's a term spun as equality when it means something very different. Equality in its true sense is a raising up while 'equity' is a race to the bottom. Everyone in the same level of poverty is 'equity'. Keep everyone down – that's equity. The Cult doesn't want anyone in the human family to be empowered and BLM leaders, like all these 'anti-racist' organisations, continue their privileged, pampered existence by perpetuating the perception of gathering racism. When is the last time you heard an 'anti-racist' or 'anti-Semitism' organisation say that acts of racism and discrimination have *fallen?* It's not in the interests of their fund-raising and power to influence and the same goes for the professional soccer anti-racism operation, Kick It Out. Two things confirmed that the Black Lives Matter riots in the summer of 2020 were Cult creations. One was that while anti-lockdown protests were condemned in this same period for 'transmitting 'Covid' the authorities supported mass gatherings of Black Lives Matter supporters. I even saw self-deluding people claiming to be doctors say the two types of protest were not the same. No – the non-existent 'Covid' was in favour of lockdowns and attacked those that protested against them while 'Covid' supported Black Lives Matter and kept well away from its protests. The whole thing was a joke and as lockdown protestors were arrested, often brutally, by reframed Face-Nappies we had the grotesque sight of police officers taking the knee to Black Lives Matter, a Cult-funded Marxist

organisation that supports violent riots and wants to destroy the nuclear family and white people.

He's not white? Shucks!

Woke obsession with race was on display again when ten people were shot dead in Boulder, Colorado, in March, 2021. Cult-owned Woke TV channels like CNN said the shooter appeared to be a white man and Wokers were on Twitter condemning 'violent white men' with the usual mantras. Then the shooter's name was released as Ahmad Al Aliwi Alissa, an anti-Trump Arab-American, and the sigh of disappointment could be heard five miles away. Never mind that ten people were dead and what that meant for their families. Race baiting was all that mattered to these sick Cult-serving people like Barack Obama who exploited the deaths to further divide America on racial grounds which is his job for the Cult. This is the man that 'racist' white Americans made the first black president of the United States and then gave him a second term. Not-very-bright Obama has become filthy rich on the back of that and today appears to have a big influence on the Biden administration. Even so he's still a downtrodden black man and a victim of white supremacy. This disingenuous fraud reveals the contempt he has for black people when he puts on a Deep South Alabama accent whenever he talks to them, no, *at* them.

Another BLM red flag was how the now fully-Woke (fully-Cult) and fully-virtue-signalled professional soccer authorities had their teams taking the knee before every match in support of Marxist Black Lives Matter. Soccer authorities and clubs displayed 'Black Lives Matter' on the players' shirts and flashed the name on electronic billboards around the pitch. Any fans that condemned what is a Freemasonic taking-the-knee ritual were widely condemned as you would expect from the Woke virtue-signallers of professional sport and the now fully-Woke media. We have reverse racism in which you are banned from criticising any race or culture except for white people for whom anything goes – say what you like, no problem. What has this got to do with racial harmony and

equality? We've had black supremacists from Black Lives Matter telling white people to fall to their knees in the street and apologise for their white supremacy. Black supremacists acting like white supremacist slave owners of the past couldn't breach their self-obsessed, race-obsessed sense of self-purity. Joe Biden appointed a race-obsessed black supremacist Kristen Clarke to head the Justice Department Civil Rights Division. Clarke claimed that blacks are endowed with 'greater mental, physical and spiritual abilities' than whites. If anyone reversed that statement they would be vilified. Clarke is on-message so no problem. She's never seen a black-white situation in which the black figure is anything but a virtuous victim and she heads the Civil Rights Division which should treat everyone the same or it isn't civil rights. Another perception of the Renegade Mind: If something or someone is part of the Cult agenda they will be supported by Woke governments and media no matter what. If they're not, they will be condemned and censored. It really is that simple and so racist Clarke prospers despite (make that because of) her racism.

The end of culture

Biden's administration is full of such racial, cultural and economic bias as the Cult requires the human family to be divided into warring factions. We are now seeing racially-segregated graduations and everything, but everything, is defined through the lens of perceived 'racism. We have 'racist' mathematics, 'racist' food and even 'racist' *plants*. World famous Kew Gardens in London said it was changing labels on plants and flowers to tell its pre-'Covid' more than two million visitors a year how racist they are. Kew director Richard Deverell said this was part of an effort to 'move quickly to decolonise collections' after they were approached by one Ajay Chhabra 'an actor with an insight into how sugar cane was linked to slavery'. They are *plants* you idiots. 'Decolonisation' in the Woke manual really means colonisation of society with its mentality and by extension colonisation by the Cult. We are witnessing a new Chinese-style 'Cultural Revolution' so essential to the success of all

Marxist takeovers. Our cultural past and traditions have to be swept away to allow a new culture to be built-back-better. Woke targeting of long-standing Western cultural pillars including historical monuments and cancelling of historical figures is what happened in the Mao revolution in China which 'purged remnants of capitalist and traditional elements from Chinese society' and installed Maoism as the dominant ideology'. For China see the Western world today and for 'dominant ideology' see Woke. Better still see Marxism or Maoism. The 'Covid' hoax has specifically sought to destroy the arts and all elements of Western culture from people meeting in a pub or restaurant to closing theatres, music venues, sports stadiums, places of worship and even banning *singing*. Destruction of Western society is also why criticism of any religion is banned except for Christianity which again is the dominant religion as white is the numerically-dominant race. Christianity may be fading rapidly, but its history and traditions are weaved through the fabric of Western society. Delete the pillars and other structures will follow until the whole thing collapses. I am not a Christian defending that religion when I say that. I have no religion. It's just a fact. To this end Christianity has itself been turned Woke to usher its own downfall and its ranks are awash with 'change agents' – knowing and unknowing – at every level including Pope Francis (*definitely* knowing) and the clueless Archbishop of Canterbury Justin Welby (possibly not, but who can be sure?). Woke seeks to coordinate attacks on Western culture, traditions, and ways of life through 'intersectionality' defined as 'the complex, cumulative way in which the effects of multiple forms of discrimination (such as racism, sexism, and classism) combine, overlap, or intersect especially in the experiences of marginalised individuals or groups'. Wade through the Orwellian Woke-speak and this means coordinating disparate groups in a common cause to overthrow freedom and liberal values.

The entire structure of public institutions has been infested with Woke – government at all levels, political parties, police, military, schools, universities, advertising, media and trade unions. This abomination has been achieved through the Cult web by appointing

Wokers to positions of power and battering non-Wokers into line through intimidation, isolation and threats to their job. Many have been fired in the wake of the empathy-deleted, vicious hostility of 'social justice' Wokers and the desire of gutless, spineless employers to virtue-signal their Wokeness. Corporations are filled with Wokers today, most notably those in Silicon Valley. Ironically at the top they are not Woke at all. They are only exploiting the mentality their Cult masters have created and funded to censor and enslave while the Wokers cheer them on until it's their turn. Thus the Woke 'liberal left' is an inversion of the traditional liberal left. Campaigning for justice on the grounds of power and wealth distribution has been replaced by campaigning for identity politics. The genuine traditional left would never have taken money from today's billionaire abusers of fairness and justice and nor would the billionaires have wanted to fund that genuine left. It would not have been in their interests to do so. The division of opinion in those days was between the haves and have nots. This all changed with Cult manipulated and funded identity politics. The division of opinion today is between Wokers and non-Wokers and not income brackets. Cult corporations and their billionaires may have taken wealth disparity to cataclysmic levels of injustice, but as long as they speak the language of Woke, hand out the dosh to the Woke network and censor the enemy they are 'one of us'. Billionaires who don't give a damn about injustice are laughing at them till their bellies hurt. Wokers are not even close to self-aware enough to see that. The transformed 'left' dynamic means that Wokers who drone on about 'social justice' are funded by billionaires that have destroyed social justice the world over. It's *why* they are billionaires.

The climate con

Nothing encapsulates what I have said more comprehensively than the hoax of human-caused global warming. I have detailed in my books over the years how Cult operatives and organisations were the pump-primers from the start of the climate con. A purpose-built vehicle for this is the Club of Rome established by the Cult in 1968

with the Rockefellers and Rothschilds centrally involved all along. Their gofer frontman Maurice Strong, a Canadian oil millionaire, hosted the Earth Summit in Rio de Janeiro, Brazil, in 1992 where the global 'green movement' really expanded in earnest under the guiding hand of the Cult. The Earth Summit established Agenda 21 through the Cult-created-and-owned United Nations to use the illusion of human-caused climate change to justify the transformation of global society to save the world from climate disaster. It is a No-Problem-Reaction-Solution sold through governments, media, schools and universities as whole generations have been terrified into believing that the world was going to end in their lifetimes unless what old people had inflicted upon them was stopped by a complete restructuring of how everything is done. Chill, kids, it's all a hoax. Such restructuring is precisely what the Cult agenda demands (purely by coincidence of course). Today this has been given the codename of the Great Reset which is only an updated term for Agenda 21 and its associated Agenda 2030. The latter, too, is administered through the UN and was voted into being by the General Assembly in 2015. Both 21 and 2030 seek centralised control of all resources and food right down to the raindrops falling on your own land. These are some of the demands of Agenda 21 established in 1992. See if you recognise this society emerging today:

- End national sovereignty
- State planning and management of all land resources, ecosystems, deserts, forests, mountains, oceans and fresh water; agriculture; rural development; biotechnology; and ensuring *'equity'*
- The state to 'define the role' of business and financial resources
- Abolition of private property
- 'Restructuring' the family unit (see BLM)
- Children raised by the state
- People told what their job will be
- Major restrictions on movement
- Creation of 'human settlement zones'

- Mass resettlement as people are forced to vacate land where they live
- Dumbing down education
- Mass global depopulation in pursuit of all the above

The United Nations was created as a Trojan horse for world government. With the climate con of critical importance to promoting that outcome you would expect the UN to be involved. Oh, it's involved all right. The UN is promoting Agenda 21 and Agenda 2030 justified by 'climate change' while also driving the climate hoax through its Intergovernmental Panel on Climate Change (IPCC), one of the world's most corrupt organisations. The IPCC has been lying ferociously and constantly since the day it opened its doors with the global media hanging unquestioningly on its every mendacious word. The Green movement is entirely Woke and has long lost its original environmental focus since it was co-opted by the Cult. An obsession with 'global warming' has deleted its values and scrambled its head. I experienced a small example of what I mean on a beautiful country walk that I have enjoyed several times a week for many years. The path merged into the fields and forests and you felt at one with the natural world. Then a 'Green' organisation, the Hampshire and Isle of Wight Wildlife Trust, took over part of the land and proceeded to cut down a large number of trees, including mature ones, to install a horrible big, bright steel 'this-is-ours-stay-out' fence that destroyed the whole atmosphere of this beautiful place. No one with a feel for nature would do that. Day after day I walked to the sound of chainsaws and a magnificent mature weeping willow tree that I so admired was cut down at the base of the trunk. When I challenged a Woke young girl in a green shirt (of course) about this vandalism she replied: 'It's a weeping willow – it will grow back.' This is what people are paying for when they donate to the Hampshire and Isle of Wight Wildlife Trust and many other 'green' organisations today. It is not the environmental movement that I knew and instead has become a support-system – as with Extinction Rebellion – for a very dark agenda.

Private jets for climate justice

The Cult-owned, Gates-funded, World Economic Forum and its founder Klaus Schwab were behind the emergence of Greta Thunberg to harness the young behind the climate agenda and she was invited to speak to the world at … the UN. Schwab published a book, *Covid-19: The Great Reset* in 2020 in which he used the 'Covid' hoax and the climate hoax to lay out a new society straight out of Agenda 21 and Agenda 2030. Bill Gates followed in early 2021 when he took time out from destroying the world to produce a book in his name about the way to save it. Gates flies across the world in private jets and admitted that 'I probably have one of the highest greenhouse gas footprints of anyone on the planet … my personal flying alone is gigantic.' He has also bid for the planet's biggest private jet operator. Other climate change saviours who fly in private jets include John Kerry, the US Special Presidential Envoy for Climate, and actor Leonardo DiCaprio, a 'UN Messenger of Peace with special focus on climate change'. These people are so full of bullshit they could corner the market in manure. We mustn't be sceptical, though, because the Gates book, *How to Avoid a Climate Disaster: The Solutions We Have and the Breakthroughs We Need*, is a genuine attempt to protect the world and not an obvious pile of excrement attributed to a mega-psychopath aimed at selling his masters' plans for humanity. The Gates book and the other shite-pile by Klaus Schwab could have been written by the same person and may well have been. Both use 'climate change' and 'Covid' as the excuses for their new society and by coincidence the Cult's World Economic Forum and Bill and Melinda Gates Foundation promote the climate hoax and hosted Event 201 which pre-empted with a 'simulation' the very 'coronavirus' hoax that would be simulated for real on humanity within weeks. The British 'royal' family is promoting the 'Reset' as you would expect through Prince 'climate change caused the war in Syria' Charles and his hapless son Prince William who said that we must 'reset our relationship with nature and our trajectory as a species' to avoid a climate disaster. Amazing how many promotors of the 'Covid' and 'climate change' control

systems are connected to Gates and the World Economic Forum. A 'study' in early 2021 claimed that carbon dioxide emissions must fall by the equivalent of a global lockdown roughly every two years for the next decade to save the planet. The 'study' appeared in the same period that the Schwab mob claimed in a video that lockdowns destroying the lives of billions are good because they make the earth 'quieter' with less 'ambient noise'. They took down the video amid a public backlash for such arrogant, empathy-deleted stupidity You see, however, where they are going with this. Corinne Le Quéré, a professor at the Tyndall Centre for Climate Change Research, University of East Anglia, was lead author of the climate lockdown study, and she writes for … the World Economic Forum. Gates calls in 'his' book for changing 'every aspect of the economy' (long-time Cult agenda) and for humans to eat synthetic 'meat' (predicted in my books) while cows and other farm animals are eliminated. Australian TV host and commentator Alan Jones described what carbon emission targets would mean for farm animals in Australia alone if emissions were reduced as demanded by 35 percent by 2030 and zero by 2050:

Well, let's take agriculture, the total emissions from agriculture are about 75 million tonnes of carbon dioxide, equivalent. Now reduce that by 35 percent and you have to come down to 50 million tonnes, I've done the maths. So if you take for example 1.5 million cows, you're going to have to reduce the herd by 525,000 [by] 2030, nine years, that's 58,000 cows a year. The beef herd's 30 million, reduce that by 35 percent, that's 10.5 million, which means 1.2 million cattle have to go every year between now and 2030. This is insanity!

There are 75 million sheep. Reduce that by 35 percent, that's 26 million sheep, that's almost 3 million a year. So under the Paris Agreement over 30 million beasts. dairy cows, cattle, pigs and sheep would go. More than 8,000 every minute of every hour for the next decade, do these people know what they're talking about?

Clearly they don't at the level of campaigners, politicians and administrators. The Cult *does* know; that's the outcome it wants. We are faced with not just a war on humanity. Animals and the natural world are being targeted and I have been saying since the 'Covid' hoax began that the plan eventually was to claim that the 'deadly virus' is able to jump from animals, including farm animals and

domestic pets, to humans. Just before this book went into production came this story: 'Russia registers world's first Covid-19 vaccine for cats & dogs as makers of Sputnik V warn pets & farm animals could spread virus'. The report said 'top scientists warned that the deadly pathogen could soon begin spreading through homes and farms' and 'the next stage is the infection of farm and domestic animals'. Know the outcome and you'll see the journey. Think what that would mean for animals and keep your eye on a term called zoonosis or zoonotic diseases which transmit between animals and humans. The Cult wants to break the connection between animals and people as it does between people and people. Farm animals fit with the Cult agenda to transform food from natural to synthetic.

The gas of life is killing us

There can be few greater examples of Cult inversion than the condemnation of carbon dioxide as a dangerous pollutant when it is the gas of life. Without it the natural world would be dead and so we would all be dead. We breathe in oxygen and breathe out carbon dioxide while plants produce oxygen and absorb carbon dioxide. It is a perfect symbiotic relationship that the Cult wants to dismantle for reasons I will come to in the final two chapters. Gates, Schwab, other Cult operatives and mindless repeaters, want the world to be 'carbon neutral' by at least 2050 and the earlier the better. 'Zero carbon' is the cry echoed by lunatics calling for 'Zero Covid' when we already have it. These carbon emission targets will deindustrialise the world in accordance with Cult plans – the post-industrial, post-democratic society – and with so-called renewables like solar and wind not coming even close to meeting human energy needs blackouts and cold are inevitable. Texans got the picture in the winter of 2021 when a snow storm stopped wind turbines and solar panels from working and the lights went down along with water which relies on electricity for its supply system. Gates wants everything to be powered by electricity to ensure that his masters have the kill switch to stop all human activity, movement, cooking, water and warmth any time they like. The climate lie is so

stupendously inverted that it claims we must urgently reduce carbon dioxide when we *don't have enough*.

Co2 in the atmosphere is a little above 400 parts per million when the optimum for plant growth is 2,000 ppm and when it falls anywhere near 150 ppm the natural world starts to die and so do we. It fell to as low as 280 ppm in an 1880 measurement in Hawaii and rose to 413 ppm in 2019 with industrialisation which is why the planet has become *greener* in the industrial period. How insane then that psychopathic madman Gates is not satisfied only with blocking the rise of Co2. He's funding technology to suck it out of the atmosphere. The reason why will become clear. The industrial era is not destroying the world through Co2 and has instead turned around a potentially disastrous ongoing fall in Co2. Greenpeace co-founder and scientist Patrick Moore walked away from Greenpeace in 1986 and has exposed the green movement for fear-mongering and lies. He said that 500 million years ago there was *17 times* more Co2 in the atmosphere than we have today and levels have been falling for hundreds of millions of years. In the last 150 million years Co2 levels in Earth's atmosphere had reduced by *90 percent*. Moore said that by the time humanity began to unlock carbon dioxide from fossil fuels we were at '38 seconds to midnight' and in that sense: 'Humans are [the Earth's] salvation.' Moore made the point that only half the Co2 emitted by fossil fuels stays in the atmosphere and we should remember that all pollution pouring from chimneys that we are told is carbon dioxide is in fact nothing of the kind. It's pollution. Carbon dioxide is an invisible gas.

William Happer, Professor of Physics at Princeton University and long-time government adviser on climate, has emphasised the Co2 deficiency for maximum growth and food production. Greenhouse growers don't add carbon dioxide for a bit of fun. He said that most of the warming in the last 100 years, after the earth emerged from the super-cold period of the 'Little Ice Age' into a natural warming cycle, was over by 1940. Happer said that a peak year for warming in 1988 can be explained by a 'monster El Nino' which is a natural and cyclical warming of the Pacific that has nothing to do with 'climate

change'. He said the effect of Co2 could be compared to painting a wall with red paint in that once two or three coats have been applied it didn't matter how much more you slapped on because the wall will not get much redder. Almost all the effect of the rise in Co2 has already happened, he said, and the volume in the atmosphere would now have to *double* to increase temperature by a single degree. Climate hoaxers know this and they have invented the most ridiculously complicated series of 'feedback' loops to try to overcome this rather devastating fact. You hear puppet Greta going on cluelessly about feedback loops and this is why.

The Sun affects temperature? No you *climate denier*

Some other nonsense to contemplate: Climate graphs show that rises in temperature do not follow rises in Co2 – *it's the other way round* with a lag between the two of some 800 years. If we go back 800 years from present time we hit the Medieval Warm Period when temperatures were higher than now without any industrialisation and this was followed by the Little Ice Age when temperatures plummeted. The world was still emerging from these centuries of serious cold when many climate records began which makes the ever-repeated line of the 'hottest year since records began' meaningless when you are not comparing like with like. The coldest period of the Little Ice Age corresponded with the lowest period of sunspot activity when the Sun was at its least active. Proper scientists will not be at all surprised by this when it confirms the obvious fact that earth temperature is affected by the scale of Sun activity and the energetic power that it subsequently emits; but when is the last time you heard a climate hoaxer talking about the Sun as a source of earth temperature?? Everything has to be focussed on Co2 which makes up just 0.117 percent of so-called greenhouse gases and only a fraction of even that is generated by human activity. The rest is natural. More than *90 percent* of those greenhouse gases are water vapour and clouds (Fig 9). Ban moisture I say. Have you noticed that the climate hoaxers no longer use the polar bear as their promotion image? That's because far from becoming extinct polar

bear communities are stable or thriving. Joe Bastardi, American meteorologist, weather forecaster and outspoken critic of the climate lie, documents in his book *The Climate Chronicles* how weather patterns and events claimed to be evidence of climate change have been happening since long before industrialisation: 'What happened before naturally is happening again, as is to be expected given the cyclical nature of the climate due to the design of the planet.' If you read the detailed background to the climate hoax in my other books you will shake your head and wonder how anyone could believe the crap which has spawned a multi-trillion dollar industry based on absolute garbage (see HIV causes AIDs and Sars-Cov-2 causes 'Covid-19'). Climate and 'Covid' have much in common given they have the same source. They both have the contradictory *everything* factor in which everything is explained by reference to them. It's hot – 'it's climate change'. It's cold – 'it's climate change'. I got a sniffle – 'it's Covid'. I haven't got a sniffle – 'it's Covid'. Not having a sniffle has to be a symptom of 'Covid'. Everything is and not having a sniffle is especially dangerous if you are a slow walker. For sheer audacity I offer you a Cambridge University 'study' that actually linked 'Covid' to 'climate change'. It had to happen eventually. They concluded that climate change played a role in 'Covid-19' spreading from animals to humans because … wait for it … I kid you not … *the two groups were forced closer together as populations grow*. Er, that's it. The whole foundation on which this depended was that 'Bats are the likely zoonotic origin of SARS-CoV-1 and SARS-CoV-2'. Well, they are not. They are nothing to do with it. Apart from bats not being the origin and therefore 'climate change' effects on bats being irrelevant I am in awe of their academic insight. Where would we be without them? Not where we are that's for sure.

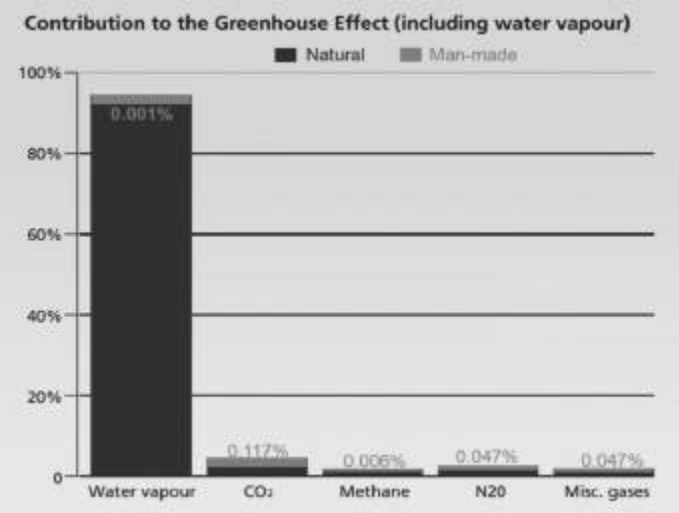

Figure 9: The idea that the gas of life is disastrously changing the climate is an insult to brain cell activity.

One other point about the weather is that climate modification is now well advanced and not every major weather event is natural – or earthquake come to that. I cover this subject at some length in other books. China is openly planning a rapid expansion of its weather modification programme which includes changing the climate in an area more than one and a half times the size of India. China used weather manipulation to ensure clear skies during the 2008 Olympics in Beijing. I have quoted from US military documents detailing how to employ weather manipulation as a weapon of war and they did that in the 1960s and 70s during the conflict in Vietnam with Operation Popeye manipulating monsoon rains for military purposes. Why would there be international treaties on weather modification if it wasn't possible? Of course it is. Weather is energetic information and it can be changed.

How was the climate hoax pulled off? See 'Covid'

If you can get billions to believe in a 'virus' that doesn't exist you can get them to believe in human-caused climate change that doesn't exist. Both are being used by the Cult to transform global society in the way it has long planned. Both hoaxes have been achieved in pretty much the same way. First you declare a lie is a fact. There's a

'virus' you call SARS-Cov-2 or humans are warming the planet with their behaviour. Next this becomes, via Cult networks, the foundation of government, academic and science policy and belief. Those who parrot the mantra are given big grants to produce research that confirms the narrative is true and ever more 'symptoms' are added to make the 'virus'/'climate change' sound even more scary. Scientists and researchers who challenge the narrative have their grants withdrawn and their careers destroyed. The media promote the lie as the unquestionable truth and censor those with an alternative view or evidence. A great percentage of the population believe what they are told as the lie becomes an everybody-knows-that and the believing-masses turn on those with a mind of their own. The technique has been used endlessly throughout human history. Wokers are the biggest promotors of the climate lie *and* 'Covid' fascism because their minds are owned by the Cult; their sense of self-righteous self-purity knows no bounds; and they exist in a bubble of reality in which facts are irrelevant and only get in the way of looking without seeing.

Running through all of this like veins in a blue cheese is control of information, which means control of perception, which means control of behaviour, which collectively means control of human society. The Cult owns the global media and Silicon Valley fascists for the simple reason that it *has* to. Without control of information it can't control perception and through that human society. Examine every facet of the Cult agenda and you will see that anything supporting its introduction is never censored while anything pushing back is always censored. I say again: Psychopaths that know why they are doing this must go before Nuremberg trials and those that follow their orders must trot along behind them into the same dock. 'I was just following orders' didn't work the first time and it must not work now. Nuremberg trials must be held all over the world before public juries for politicians, government officials, police, compliant doctors, scientists and virologists, and all Cult operatives such as Gates, Tedros, Fauci, Vallance, Whitty, Ferguson, Zuckerberg, Wojcicki, Brin, Page, Dorsey, the whole damn lot of

them – including, no *especially*, the psychopath psychologists. Without them and the brainless, gutless excuses for journalists that have repeated their lies, none of this could be happening. Nobody can be allowed to escape justice for the psychological and economic Armageddon they are all responsible for visiting upon the human race.

As for the compliant, unquestioning, swathes of humanity, and the self-obsessed, all-knowing ignorance of the Wokers … don't start me. God help their kids. God help their grandkids. God *help them*.

CHAPTER NINE

We must have it? So what is it?

Well I won't back down. No, I won't back down. You can stand me up at the Gates of Hell. But I won't back down
Tom Petty

I will now focus on the genetically-manipulating 'Covid vaccines' which do not meet this official definition of a vaccine by the US Centers for Disease Control (CDC): 'A product that stimulates a person's immune system to produce immunity to a specific disease, protecting the person from that disease.' On that basis 'Covid vaccines' are not a vaccine in that the makers don't even claim they stop infection or transmission.

They are instead part of a multi-levelled conspiracy to change the nature of the human body and what it means to be 'human' and to depopulate an enormous swathe of humanity. What I shall call Human 1.0 is on the cusp of becoming Human 2.0 and for very sinister reasons. Before I get to the 'Covid vaccine' in detail here's some background to vaccines in general. Government regulators do not test vaccines – the makers do – and the makers control which data is revealed and which isn't. Children in America are given 50 vaccine doses by age six and 69 by age 19 and the effect of the whole combined schedule has never been tested. Autoimmune diseases when the immune system attacks its own body have soared in the mass vaccine era and so has disease in general in children and the young. Why wouldn't this be the case when vaccines target the *immune system?* The US government gave Big Pharma drug

companies immunity from prosecution for vaccine death and injury in the 1986 National Childhood Vaccine Injury Act (NCVIA) and since then the government (taxpayer) has been funding compensation for the consequences of Big Pharma vaccines. The criminal and satanic drug giants can't lose and the vaccine schedule has increased dramatically since 1986 for this reason. There is no incentive to make vaccines safe and a big incentive to make money by introducing ever more. Even against a ridiculously high bar to prove vaccine liability, and with the government controlling the hearing in which it is being challenged for compensation, the vaccine court has so far paid out more than $4 billion. These are the vaccines we are told are safe and psychopaths like Zuckerberg censor posts saying otherwise. The immunity law was even justified by a ruling that vaccines by their nature were 'unavoidably unsafe'.

Check out the ingredients of vaccines and you will be shocked if you are new to this. *They put that in children's bodies?? What??* Try aluminium, a brain toxin connected to dementia, aborted foetal tissue and formaldehyde which is used to embalm corpses. World-renowned aluminium expert Christopher Exley had his research into the health effect of aluminium in vaccines shut down by Keele University in the UK when it began taking funding from the Bill and Melinda Gates Foundation. Research when diseases 'eradicated' by vaccines began to decline and you will find the fall began long *before* the vaccine was introduced. Sometimes the fall even plateaued after the vaccine. Diseases like scarlet fever for which there was no vaccine declined in the same way because of environmental and other factors. A perfect case in point is the polio vaccine. Polio began when lead arsenate was first sprayed as an insecticide and residues remained in food products. Spraying started in 1892 and the first US polio epidemic came in Vermont in 1894. The simple answer was to stop spraying, but Rockefeller-created Big Pharma had a better idea. Polio was decreed to be caused by the *poliovirus* which 'spreads from person to person and can infect a person's spinal cord'. Lead arsenate was replaced by the lethal DDT which had the same effect of causing paralysis by damaging the brain and central nervous

system. Polio plummeted when DDT was reduced and then banned, but the vaccine is still given the credit for something it didn't do. Today by far the biggest cause of polio is the vaccines promoted by Bill Gates. Vaccine justice campaigner Robert Kennedy Jr, son of assassinated (by the Cult) US Attorney General Robert Kennedy, wrote:

> In 2017, the World Health Organization (WHO) reluctantly admitted that the global explosion in polio is predominantly vaccine strain. The most frightening epidemics in Congo, Afghanistan, and the Philippines, are all linked to vaccines. In fact, by 2018, 70% of global polio cases were vaccine strain.

Vaccines make fortunes for Cult-owned Gates and Big Pharma while undermining the health and immune systems of the population. We had a glimpse of the mentality behind the Big Pharma cartel with a report on WION (World is One News), an international English language TV station based in India, which exposed the extraordinary behaviour of US drug company Pfizer over its 'Covid vaccine'. The WION report told how Pfizer had made fantastic demands of Argentina, Brazil and other countries in return for its 'vaccine'. These included immunity from prosecution, even for Pfizer negligence, government insurance to protect Pfizer from law suits and handing over as collateral sovereign assets of the country to include Argentina's bank reserves, military bases and embassy buildings. Pfizer demanded the same of Brazil in the form of waiving sovereignty of its assets abroad; exempting Pfizer from Brazilian laws; and giving Pfizer immunity from all civil liability. This is a 'vaccine' developed with government funding. Big Pharma is evil incarnate as a creation of the Cult and all must be handed tickets to Nuremberg.

Phantom 'vaccine' for a phantom 'disease'

I'll expose the 'Covid vaccine' fraud and then go on to the wider background of why the Cult has set out to 'vaccinate' every man, woman and child on the planet for an alleged 'new disease' with a survival rate of 99.77 percent (or more) even by the grotesquely-

manipulated figures of the World Health Organization and Johns Hopkins University. The 'infection' to 'death' ratio is 0.23 to 0.15 percent according to Stanford epidemiologist Dr John Ioannidis and while estimates vary the danger remains tiny. I say that if the truth be told the fake infection to fake death ratio is zero. Never mind all the evidence I have presented here and in *The Answer* that there is no 'virus' let us just focus for a moment on that death-rate figure of say 0.23 percent. The figure includes all those worldwide who have tested positive with a test not testing for the 'virus' and then died within 28 days or even longer of any other cause – *any other cause*. Now subtract all those illusory 'Covid' deaths on the global data sheets from the 0.23 percent. What do you think you would be left with? *Zero*. A vaccination has never been successfully developed for a so-called coronavirus. They have all failed at the animal testing stage when they caused hypersensitivity to what they were claiming to protect against and made the impact of a disease far worse. Cult-owned vaccine corporations got around that problem this time by bypassing animal trials, going straight to humans and making the length of the 'trials' before the public rollout as short as they could get away with. Normally it takes five to ten years or more to develop vaccines that still cause demonstrable harm to many people and that's without including the long-term effects that are never officially connected to the vaccination. 'Covid' non-vaccines have been officially produced and approved in a matter of months from a standing start and part of the reason is that (a) they were developed before the 'Covid' hoax began and (b) they are based on computer programs and not natural sources. Official non-trials were so short that government agencies gave *emergency*, not full, approval. 'Trials' were not even completed and full approval cannot be secured until they are. Public 'Covid vaccination' is actually a *continuation of the trial*. Drug company 'trials' are not scheduled to end until 2023 by which time a lot of people are going to be dead. Data on which government agencies gave this emergency approval was supplied by the Big Pharma corporations themselves in the form of Pfizer/BioNTech, AstraZeneca, Moderna, Johnson & Johnson, and

others, and this is the case with all vaccines. By its very nature *emergency* approval means drug companies do not have to prove that the 'vaccine' is 'safe and effective'. How could they with trials way short of complete? Government regulators only have to *believe* that they *could* be safe and effective. It is criminal manipulation to get products in circulation with no testing worth the name. Agencies giving that approval are infested with Big Pharma-connected place-people and they act in the interests of Big Pharma (the Cult) and not the public about whom they do not give a damn.

More human lab rats

'Covid vaccines' produced in record time by Pfizer/BioNTech and Moderna employ a technique *never approved before for use on humans*. They are known as mRNA 'vaccines' and inject a synthetic version of 'viral' mRNA or 'messenger RNA'. The key is in the term 'messenger'. The body works, or doesn't, on the basis of information messaging. Communications are constantly passing between and within the genetic system and the brain. Change those messages and you change the state of the body and even its very nature and you can change psychology and behaviour by the way the brain processes information. I think you are going to see significant changes in personality and perception of many people who have had the 'Covid vaccine' synthetic potions. Insider Aldous Huxley predicted the following in 1961 and mRNA 'vaccines' can be included in the term 'pharmacological methods':

> There will be, in the next generation or so, a pharmacological method of making people love their servitude, and producing dictatorship without tears, so to speak, producing a kind of painless concentration camp for entire societies, so that people will in fact have their own liberties taken away from them, but rather enjoy it, because they will be distracted from any desire to rebel by propaganda or brainwashing, or brainwashing enhanced by pharmacological methods. And this seems to be the final revolution.

Apologists claim that mRNA synthetic 'vaccines' don't change the DNA genetic blueprint because RNA does not affect DNA only the other way round. This is so disingenuous. A process called 'reverse

transcription' can convert RNA into DNA and be integrated into DNA in the cell nucleus. This was highlighted in December, 2020, by scientists at Harvard and Massachusetts Institute of Technology (MIT). Geneticists report that more than 40 percent of mammalian genomes results from reverse transcription. On the most basic level if messaging changes then that sequence must lead to changes in DNA which is receiving and transmitting those communications. How can introducing synthetic material into cells not change the cells where DNA is located? The process is known as transfection which is defined as 'a technique to insert foreign nucleic acid (DNA or RNA) into a cell, typically with the intention of altering the properties of the cell'. Researchers at the Sloan Kettering Institute in New York found that changes in messenger RNA can deactivate tumour-suppressing proteins and thereby promote cancer. This is what happens when you mess with messaging. 'Covid vaccine' maker Moderna was founded in 2010 by Canadian stem cell biologist Derrick J. Rossi after his breakthrough discovery in the field of transforming and reprogramming stem cells. These are neutral cells that can be programmed to become any cell including sperm cells. Moderna was therefore founded on the principle of genetic manipulation and has never produced any vaccine or drug before its genetically-manipulating synthetic 'Covid' shite. Look at the name – Mode-RNA or Modify-RNA. Another important point is that the US Supreme Court has ruled that genetically-modified DNA, or complementary DNA (cDNA) synthesized in the laboratory from messenger RNA, can be patented and owned. These psychopaths are doing this to the human body.

Cells replicate synthetic mRNA in the 'Covid vaccines' and in theory the body is tricked into making antigens which trigger antibodies to target the 'virus spike proteins' which as Dr Tom Cowan said have *never been seen*. Cut the crap and these 'vaccines' deliver *self-replicating* synthetic material to the cells with the effect of changing human DNA. The more of them you have the more that process is compounded while synthetic material is all the time self-replicating. 'Vaccine'-maker Moderna describes mRNA as 'like

software for the cell' and so they are messing with the body's software. What happens when you change the software in a computer? Everything changes. For this reason the Cult is preparing a production line of mRNA 'Covid vaccines' and a long list of excuses to use them as with all the 'variants' of a 'virus' never shown to exist. The plan is further to transfer the mRNA technique to other vaccines mostly given to children and young people. The cumulative consequences will be a transformation of human DNA through a constant infusion of synthetic genetic material which will kill many and change the rest. Now consider that governments that have given emergency approval for a vaccine that's not a vaccine; never been approved for humans before; had no testing worth the name; and the makers have been given immunity from prosecution for any deaths or adverse effects suffered by the public. The UK government awarded *permanent legal indemnity* to itself and its employees for harm done when a patient is being treated for 'Covid-19' or 'suspected Covid-19'. That is quite a thought when these are possible 'side-effects' from the 'vaccine' (they are not 'side', they are effects) listed by the US Food and Drug Administration:

Guillain-Barre syndrome; acute disseminated encephalomyelitis; transverse myelitis; encephalitis; myelitis; encephalomyelitis; meningoencephalitis; meningitis; encephalopathy; convulsions; seizures; stroke; narcolepsy; cataplexy; anaphylaxis; acute myocardial infarction (heart attack); myocarditis; pericarditis; autoimmune disease; death; implications for pregnancy, and birth outcomes; other acute demyelinating diseases; non anaphylactic allergy reactions; thrombocytopenia ; disseminated intravascular coagulation; venous thromboembolism; arthritis; arthralgia; joint pain; Kawasaki disease; multisystem inflammatory syndrome in children; vaccine enhanced disease. The latter is the way the 'vaccine' has the potential to make diseases far worse than they would otherwise be.

UK doctor and freedom campaigner Vernon Coleman described the conditions in this list as 'all unpleasant, most of them very serious, and you can't get more serious than death'. The thought that anyone at all has had the 'vaccine' in these circumstances is testament to the potential that humanity has for clueless, unquestioning, stupidity and for many that programmed stupidity has already been terminal.

An insider speaks

Dr Michael Yeadon is a former Vice President, head of research and Chief Scientific Adviser at vaccine giant Pfizer. Yeadon worked on the inside of Big Pharma, but that did not stop him becoming a vocal critic of 'Covid vaccines' and their potential for multiple harms, including infertility in women. By the spring of 2021 he went much further and even used the no, no, term 'conspiracy'. When you begin to see what is going on it is impossible not to do so. Yeadon spoke out in an interview with freedom campaigner James Delingpole and I mentioned earlier how he said that no one had samples of 'the virus'. He explained that the mRNA technique originated in the anti-cancer field and ways to turn on and off certain genes which could be advantageous if you wanted to stop cancer growing out of control. 'That's the origin of them. They are a very unusual application, really.' Yeadon said that treating a cancer patient with an aggressive procedure might be understandable if the alternative was dying, but it was quite another thing to use the same technique as a public health measure. Most people involved wouldn't catch the infectious agent you were vaccinating against and if they did they probably wouldn't die:

> If you are really using it as a public health measure you really want to as close as you can get to zero sides-effects … I find it odd that they chose techniques that were really cutting their teeth in the field of oncology and I'm worried that in using gene-based vaccines that have to be injected in the body and spread around the body, get taken up into some cells, and the regulators haven't quite told us which cells they get taken up into … you are going to be generating a wide range of responses … with multiple steps each of which could go well or badly.

I doubt the Cult intends it to go well. Yeadon said that you can put any gene you like into the body through the 'vaccine'. 'You can certainly give them a gene that would do them some harm if you wanted.' I was intrigued when he said that when used in the cancer field the technique could turn genes on and off. I explore this process in *The Answer* and with different genes having different functions you could create mayhem – physically and psychologically – if you turned the wrong ones on and the right ones off. I read reports of an experiment by researchers at the University of Washington's school of computer science and engineering in which they encoded DNA to infect computers. The body is itself a biological computer and if human DNA can inflict damage on a computer why can't the computer via synthetic material mess with the human body? It can. The Washington research team said it was possible to insert malicious malware into 'physical DNA strands' and corrupt the computer system of a gene sequencing machine as it 'reads gene letters and stores them as binary digits 0 and 1'. They concluded that hackers could one day use blood or spit samples to access computer systems and obtain sensitive data from police forensics labs or infect genome files. It is at this level of digital interaction that synthetic 'vaccines' need to be seen to get the full picture and that will become very clear later on. Michael Yeadon said it made no sense to give the 'vaccine' to younger people who were in no danger from the 'virus'. What was the benefit? It was all downside with potential effects:

> The fact that my government in what I thought was a civilised, rational country, is raining [the 'vaccine'] on people in their 30s and 40s, even my children in their 20s, they're getting letters and phone calls, I know this is not right and any of you doctors who are vaccinating you know it's not right, too. They are not at risk. They are not at risk from the disease, so you are now hoping that the side-effects are so rare that you get away with it. You don't give new technology … that you don't understand to 100 percent of the population.

Blood clot problems with the AstraZeneca 'vaccine' have been affecting younger people to emphasise the downside risks with no benefit. AstraZeneca's version, produced with Oxford University, does not use mRNA, but still gets its toxic cocktail inside cells where

it targets DNA. The Johnson & Johnson 'vaccine' which uses a similar technique has also produced blood clot effects to such an extent that the United States paused its use at one point. They are all 'gene therapy' (cell modification) procedures and not 'vaccines'. The truth is that once the content of these injections enter cells we have no idea what the effect will be. People can speculate and some can give very educated opinions and that's good. In the end, though, only the makers know what their potions are designed to do and even they won't know every last consequence. Michael Yeadon was scathing about doctors doing what they knew to be wrong. 'Everyone's mute', he said. Doctors in the NHS must know this was not right, coming into work and injecting people. 'I don't know how they sleep at night. I know I couldn't do it. I know that if I were in that position I'd have to quit.' He said he knew enough about toxicology to know this was not a good risk-benefit. Yeadon had spoken to seven or eight university professors and all except two would not speak out publicly. Their universities had a policy that no one said anything that countered the government and its medical advisors. They were afraid of losing their government grants. This is how intimidation has been used to silence the truth at every level of the system. I say silence, but these people could still speak out if they made that choice. Yeadon called them 'moral cowards' – 'This is about your children and grandchildren's lives and you have just buggered off and left it.'

'Variant' nonsense

Some of his most powerful comments related to the alleged 'variants' being used to instil more fear, justify more lockdowns, and introduce more 'vaccines'. He said government claims about 'variants' were nonsense. He had checked the alleged variant 'codes' and they were 99.7 percent identical to the 'original'. This was the human identity difference equivalent to putting a baseball cap on and off or wearing it the other way round. A 0.3 percent difference would make it impossible for that 'variant' to escape immunity from the 'original'. This made no sense of having new 'vaccines' for

'variants'. He said there would have to be at least a *30 percent* difference for that to be justified and even then he believed the immune system would still recognise what it was. Gates-funded 'variant modeller' and 'vaccine'-pusher John Edmunds might care to comment. Yeadon said drug companies were making new versions of the 'vaccine' as a 'top up' for 'variants'. Worse than that, he said, the 'regulators' around the world like the MHRA in the UK had got together and agreed that because 'vaccines' for 'variants' were so similar to the first 'vaccines' *they did not have to do safety studies*. How transparently sinister that is. This is when Yeadon said: 'There is a conspiracy here.' There was no need for another vaccine for 'variants' and yet we were told that there was and the country had shut its borders because of them. 'They are going into hundreds of millions of arms without passing 'go' or any regulator. Why did they do that? Why did they pick this method of making the vaccine?'

The reason had to be something bigger than that it seemed and 'it's not protection against the virus'. It's was a far bigger project that meant politicians and advisers were willing to do things and not do things that knowingly resulted in avoidable deaths – 'that's already happened when you think about lockdown and deprivation of health care for a year.' He spoke of people prepared to do something that results in the avoidable death of their fellow human beings and it not bother them. This is the penny-drop I have been working to get across for more than 30 years – the level of pure evil we are dealing with. Yeadon said his friends and associates could not believe there could be that much evil, but he reminded them of Stalin, Pol Pot and Hitler and of what Stalin had said: 'One death is a tragedy. A million? A statistic.' He could not think of a benign explanation for why you need top-up vaccines 'which I'm sure you don't' and for the regulators 'to just get out of the way and wave them through'. Why would the regulators do that when they were still wrestling with the dangers of the 'parent' vaccine? He was clearly shocked by what he had seen since the 'Covid' hoax began and now he was thinking the previously unthinkable:

If you wanted to depopulate a significant proportion of the world and to do it in a way that doesn't involve destruction of the environment with nuclear weapons, poisoning everyone with anthrax or something like that, and you wanted plausible deniability while you had a multi-year infectious disease crisis, I actually don't think you could come up with a better plan of work than seems to be in front of me. I can't say that's what they are going to do, but I can't think of a benign explanation why they are doing it.

He said he never thought that they would get rid of 99 percent of humans, but now he wondered. 'If you wanted to that this would be a hell of a way to do it – it would be unstoppable folks.' Yeadon had concluded that those who submitted to the 'vaccine' would be allowed to have some kind of normal life (but for how long?) while screws were tightened to coerce and mandate the last few percent. 'I think they'll put the rest of them in a prison camp. I wish I was wrong, but I don't think I am.' Other points he made included: There were no coronavirus vaccines then suddenly they all come along at the same time; we have no idea of the long term affect with trials so short; coercing or forcing people to have medical procedures is against the Nuremberg Code instigated when the Nazis did just that; people should at least delay having the 'vaccine'; a quick Internet search confirms that masks don't reduce respiratory viral transmission and 'the government knows that'; they have smashed civil society and they know that, too; two dozen peer-reviewed studies show no connection between lockdown and reducing deaths; he knew from personal friends the elite were still flying around and going on holiday while the public were locked down; the elite were not having the 'vaccines'. He was also asked if 'vaccines' could be made to target difference races. He said he didn't know, but the document by the Project for the New American Century in September, 2000, said developing 'advanced forms of biological warfare that can target *specific genotypes* may transform biological warfare from the realm of terror to a politically useful tool.' Oh, they're evil all right. Of that we can be *absolutely* sure.

Another cull of old people

We have seen from the CDC definition that the mRNA 'Covid vaccine' is not a vaccine and nor are the others that *claim* to reduce 'severity of symptoms' in *some* people, but not protect from infection or transmission. What about all the lies about returning to 'normal' if people were 'vaccinated'? If they are not claimed to stop infection and transmission of the alleged 'virus', how does anything change? This was all lies to manipulate people to take the jabs and we are seeing that now with masks and distancing still required for the 'vaccinated'. How did they think that elderly people with fragile health and immune responses were going to be affected by infusing their cells with synthetic material and other toxic substances? They *knew* that in the short and long term it would be devastating and fatal as the culling of the old that began with the first lockdowns was continued with the 'vaccine'. Death rates in care homes soared immediately residents began to be 'vaccinated' – infused with synthetic material. Brave and committed whistleblower nurses put their careers at risk by exposing this truth while the rest kept their heads down and their mouths shut to put their careers before those they are supposed to care for. A long-time American Certified Nursing Assistant who gave his name as James posted a video in which he described emotionally what happened in his care home when vaccination began. He said that during 2020 very few residents were sick with 'Covid' and no one died during the entire year; but shortly after the Pfizer mRNA injections 14 people died within two weeks and many others were near death. 'They're dropping like flies', he said. Residents who walked on their own before the shot could no longer and they had lost their ability to conduct an intelligent conversation. The home's management said the sudden deaths were caused by a 'super-spreader' of 'Covid-19'. Then how come, James asked, that residents who refused to take the injections were not sick? It was a case of inject the elderly with mRNA synthetic potions and blame their illness and death that followed on the 'virus'. James described what was happening in care homes as 'the greatest crime of genocide this country has ever seen'. Remember the NHS staff nurse from earlier who used the same

word ‘genocide’ for what was happening with the ‘vaccines’ and that it was an ‘act of human annihilation’. A UK care home whistleblower told a similar story to James about the effect of the ‘vaccine’ in deaths and ‘outbreaks’ of illness dubbed ‘Covid’ after getting the jab. She told how her care home management and staff had zealously imposed government regulations and no one was allowed to even question the official narrative let alone speak out against it. She said the NHS was even worse. Again we see the results of reframing. A worker at a local care home where I live said they had not had a single case of ‘Covid’ there for almost a year and when the residents were ‘vaccinated’ they had 19 positive cases in two weeks with eight dying.

It’s not the ‘vaccine’ – honest

The obvious cause and effect was being ignored by the media and most of the public. Australia’s health minister Greg Hunt (a former head of strategy at the World Economic Forum) was admitted to hospital after he had the ‘vaccine’. He was suffering according to reports from the skin infection ‘cellulitis’ and it must have been a severe case to have warranted days in hospital. Immediately the authorities said this was nothing to do with the ‘vaccine’ when an effect of some vaccines is a ‘cellulitis-like reaction’. We had families of perfectly healthy old people who died after the ‘vaccine’ saying that if only they had been given the ‘vaccine’ earlier they would still be alive. As a numbskull rating that is off the chart. A father of four ‘died of Covid’ at aged 48 when he was taken ill two days after having the ‘vaccine’. The man, a health administrator, had been ‘shielding during the pandemic’ and had ‘not really left the house’ until he went for the ‘vaccine’. Having the ‘vaccine’ and then falling ill and dying does not seem to have qualified as a possible cause and effect and ‘Covid-19’ went on his death certificate. His family said they had no idea how he ‘caught the virus’. A family member said: ‘Tragically, it could be that going for a vaccination ultimately led to him catching Covid …The sad truth is that they are never going to know where it came from.’ The family warned people to remember

that the virus still existed and was 'very real'. So was their stupidity. Nurses and doctors who had the first round of the 'vaccine' were collapsing, dying and ending up in a hospital bed while they or their grieving relatives were saying they'd still have the 'vaccine' again despite what happened. I kid you not. You mean if your husband returned from the dead he'd have the same 'vaccine' again that killed him??

Doctors at the VCU Medical Center in Richmond, Virginia, said the Johnson & Johnson 'vaccine' was to blame for a man's skin peeling off. Patient Richard Terrell said: 'It all just happened so fast. My skin peeled off. It's still coming off on my hands now.' He said it was stinging, burning and itching and when he bent his arms and legs it was very painful with 'the skin swollen and rubbing against itself'. Pfizer/BioNTech and Moderna vaccines use mRNA to change the cell while the Johnson & Johnson version uses DNA in a process similar to AstraZeneca's technique. Johnson & Johnson and AstraZeneca have both had their 'vaccines' paused by many countries after causing serious blood problems. Terrell's doctor Fnu Nutan said he could have died if he hadn't got medical attention. It sounds terrible so what did Nutan and Terrell say about the 'vaccine' now? Oh, they still recommend that people have it. A nurse in a hospital bed 40 minutes after the vaccination and unable to swallow due to throat swelling was told by a doctor that he lost mobility in his arm for 36 hours following the vaccination. What did he say to the ailing nurse? 'Good for you for getting the vaccination.' We are dealing with a serious form of cognitive dissonance madness in both public and medical staff. There is a remarkable correlation between those having the 'vaccine' and trumpeting the fact and suffering bad happenings shortly afterwards. Witold Rogiewicz, a Polish doctor, made a video of his 'vaccination' and ridiculed those who were questioning its safety and the intentions of Bill Gates: 'Vaccinate yourself to protect yourself, your loved ones, friends and also patients. And to mention quickly I have info for anti-vaxxers and anti-Coviders if you want to contact Bill Gates you can do this through me.' He further ridiculed the dangers of 5G. Days later he

was dead, but naturally the vaccination wasn't mentioned in the verdict of 'heart attack'.

Lies, lies and more lies

So many members of the human race have slipped into extreme states of insanity and unfortunately they include reframed doctors and nursing staff. Having a 'vaccine' and dying within minutes or hours is not considered a valid connection while death from any cause within 28 days or longer of a positive test with a test not testing for the 'virus' means 'Covid-19' goes on the death certificate. How could that 'vaccine'-death connection not have been made except by calculated deceit? US figures in the initial rollout period to February 12th, 2020, revealed that a third of the deaths reported to the CDC after 'Covid vaccines' happened within 48 hours. Five men in the UK suffered an 'extremely rare' blood clot problem after having the AstraZeneca 'vaccine', but no causal link was established said the Gates-funded Medicines and Healthcare products Regulatory Agency (MHRA) which had given the 'vaccine' emergency approval to be used. Former Pfizer executive Dr Michael Yeadon explained in his interview how the procedures could cause blood coagulation and clots. People who should have been at no risk were dying from blood clots in the brain and he said he had heard from medical doctor friends that people were suffering from skin bleeding and massive headaches. The AstraZeneca 'shot' was stopped by some 20 countries over the blood clotting issue and still the corrupt MHRA, the European Medicines Agency (EMA) and the World Health Organization said that it should continue to be given even though the EMA admitted that it 'still cannot rule out definitively' a link between blood clotting and the 'vaccine'. Later Marco Cavaleri, head of EMA vaccine strategy, said there was indeed a clear link between the 'vaccine' and thrombosis, but they didn't know why. So much for the trials showing the 'vaccine' is safe. Blood clots were affecting younger people who would be under virtually no danger from 'Covid' even if it existed which makes it all the more stupid and sinister.

The British government responded to public alarm by wheeling out June Raine, the terrifyingly weak infant school headmistress sound-alike who heads the UK MHRA drug 'regulator'. The idea that she would stand up to Big Pharma and government pressure is laughable and she told us that all was well in the same way that she did when allowing untested, never-used-on-humans-before, genetically-manipulating 'vaccines' to be exposed to the public in the first place. Mass lying is the new normal of the 'Covid' era. The MHRA later said 30 cases of rare blood clots had by then been connected with the AstraZeneca 'vaccine' (that means a lot more in reality) while stressing that the benefits of the jab in preventing 'Covid-19' outweighed any risks. A more ridiculous and disingenuous statement with callous disregard for human health it is hard to contemplate. Immediately after the mendacious 'all-clears' two hospital workers in Denmark experienced blood clots and cerebral haemorrhaging following the AstraZeneca jab and one died. Top Norwegian health official Pål Andre Holme said the 'vaccine' was the only common factor: 'There is nothing in the patient history of these individuals that can give such a powerful immune response … I am confident that the antibodies that we have found are the cause, and I see no other explanation than it being the vaccine which triggers it.' Strokes, a clot or bleed in the brain, were clearly associated with the 'vaccine' from word of mouth and whistleblower reports. Similar consequences followed with all these 'vaccines' that we were told were so safe and as the numbers grew by the day it was clear we were witnessing human carnage.

Learning the hard way

A woman interviewed by UKColumn told how her husband suffered dramatic health effects after the vaccine when he'd been in good health all his life. He went from being a little unwell to losing all feeling in his legs and experiencing 'excruciating pain'. Misdiagnosis followed twice at Accident and Emergency (an 'allergy' and 'sciatica') before he was admitted to a neurology ward where doctors said his serious condition had been caused by the

'vaccine'. Another seven 'vaccinated' people were apparently being treated on the same ward for similar symptoms. The woman said he had the 'vaccine' because they believed media claims that it was safe. 'I didn't think the government would give out a vaccine that does this to somebody; I believed they would be bringing out a vaccination that would be safe.' What a tragic way to learn that lesson. Another woman posted that her husband was transporting stroke patients to hospital on almost every shift and when he asked them if they had been 'vaccinated' for 'Covid' they all replied 'yes'. One had a 'massive brain bleed' the day after his second dose. She said her husband reported the 'just been vaccinated' information every time to doctors in A and E only for them to ignore it, make no notes and appear annoyed that it was even mentioned. This particular report cannot be verified, but it expresses a common theme that confirms the monumental underreporting of 'vaccine' consequences. Interestingly as the 'vaccines' and their brain blood clot/stroke consequences began to emerge the UK National Health Service began a publicity campaign telling the public what to do in the event of a stroke. A Scottish NHS staff nurse who quit in disgust in March, 2021, said:

I have seen traumatic injuries from the vaccine, they're not getting reported to the yellow card [adverse reaction] scheme, they're treating the symptoms, not asking why, why it's happening. It's just treating the symptoms and when you speak about it you're dismissed like you're crazy, I'm not crazy, I'm not crazy because every other colleague I've spoken to is terrified to speak out, they've had enough.

Videos appeared on the Internet of people uncontrollably shaking after the 'vaccine' with no control over muscles, limbs and even their face. A Scottish mother broke out in a severe rash all over her body almost immediately after she was given the AstraZeneca 'vaccine'. The pictures were horrific. Leigh King, a 41-year-old hairdresser from Lanarkshire said: 'Never in my life was I prepared for what I was about to experience … My skin was so sore and constantly hot … I have never felt pain like this …' But don't you worry, the 'vaccine' is perfectly safe. Then there has been the effect on medical

staff who have been pressured to have the 'vaccine' by psychopathic 'health' authorities and government. A London hospital consultant who gave the name K. Polyakova wrote this to the *British Medical Journal* or *BMJ*:

> I am currently struggling with … the failure to report the reality of the morbidity caused by our current vaccination program within the health service and staff population. The levels of sickness after vaccination is unprecedented and staff are getting very sick and some with neurological symptoms which is having a huge impact on the health service function. Even the young and healthy are off for days, some for weeks, and some requiring medical treatment. Whole teams are being taken out as they went to get vaccinated together.
>
> Mandatory vaccination in this instance is stupid, unethical and irresponsible when it comes to protecting our staff and public health. We are in the voluntary phase of vaccination, and encouraging staff to take an unlicensed product that is impacting on their immediate health … it is clearly stated that these vaccine products do not offer immunity or stop transmission. In which case why are we doing it?

Not to protect health that's for sure. Medical workers are lauded by governments for agenda reasons when they couldn't give a toss about them any more than they can for the population in general. Schools across America faced the same situation as they closed due to the high number of teachers and other staff with bad reactions to the Pfizer/BioNTech, Moderna, and Johnson & Johnson 'Covid vaccines' all of which were linked to death and serious adverse effects. The *BMJ* took down the consultant's comments pretty quickly on the grounds that they were being used to spread 'disinformation'. They were exposing the truth about the 'vaccine' was the real reason. The cover-up is breathtaking.

Hiding the evidence

The scale of the 'vaccine' death cover-up worldwide can be confirmed by comparing official figures with the personal experience of the public. I heard of many people in my community who died immediately or soon after the vaccine that would never appear in the media or even likely on the official totals of 'vaccine' fatalities and adverse reactions when only about ten percent are estimated to be

reported and I have seen some estimates as low as one percent in a Harvard study. In the UK alone by April 29th, 2021, some 757,654 adverse reactions had been officially reported from the Pfizer/BioNTech, Oxford/AstraZeneca and Moderna 'vaccines' with more than a thousand deaths linked to jabs and that means an estimated ten times this number in reality from a ten percent reporting rate percentage. That's seven million adverse reactions and 10,000 potential deaths and a one percent reporting rate would be ten times *those* figures. In 1976 the US government pulled the swine flu vaccine after *53* deaths. The UK data included a combined 10,000 eye disorders from the 'Covid vaccines' with more than 750 suffering visual impairment or blindness and again multiply by the estimated reporting percentages. As 'Covid cases' officially fell hospitals virtually empty during the 'Covid crisis' began to fill up with a range of other problems in the wake of the 'vaccine' rollout. The numbers across America have also been catastrophic. Deaths linked to *all* types of vaccine increased by *6,000 percent* in the first quarter of 2021 compared with 2020. A 39-year-old woman from Ogden, Utah, died four days after receiving a second dose of Moderna's 'Covid vaccine' when her liver, heart and kidneys all failed despite the fact that she had no known medical issues or conditions. Her family sought an autopsy, but Dr Erik Christensen, Utah's chief medical examiner, said proving vaccine injury as a cause of death almost never happened. He could think of only one instance where an autopsy would name a vaccine as the official cause of death and that would be anaphylaxis where someone received a vaccine and died almost instantaneously. 'Short of that, it would be difficult for us to definitively say this is the vaccine,' Christensen said. If that is true this must be added to the estimated ten percent (or far less) reporting rate of vaccine deaths and serious reactions and the conclusion can only be that vaccine deaths and serious reactions – including these 'Covid' potions' – are phenomenally understated in official figures. The same story can be found everywhere. Endless accounts of deaths and serious reactions among the public, medical

and care home staff while official figures did not even begin to reflect this.

Professional script-reader Dr David Williams, a 'top public-health official' in Ontario, Canada, insulted our intelligence by claiming only four serious adverse reactions and no deaths from the more than 380,000 vaccine doses then given. This bore no resemblance to what people knew had happened in their owns circles and we had Dirk Huyer in charge of getting millions vaccinated in Ontario while at the same time he was Chief Coroner for the province investigating causes of death including possible death from the vaccine. An aide said he had stepped back from investigating deaths, but evidence indicated otherwise. Rosemary Frei, who secured a Master of Science degree in molecular biology at the Faculty of Medicine at Canada's University of Calgary before turning to investigative journalism, was one who could see that official figures for 'vaccine' deaths and reactions made no sense. She said that doctors seldom reported adverse events and when people got really sick or died after getting a vaccination they would attribute that to anything except the vaccines. It had been that way for years and anyone who wondered aloud whether the 'Covid vaccines' or other shots cause harm is immediately branded as 'anti-vax' and 'anti-science'. This was 'career-threatening' for health professionals. Then there was the huge pressure to support the push to 'vaccinate' billions in the quickest time possible. Frei said:

> So that's where we're at today. More than half a million vaccine doses have been given to people in Ontario alone. The rush is on to vaccinate all 15 million of us in the province by September. And the mainstream media are screaming for this to be sped up even more. That all adds up to only a very slim likelihood that we're going to be told the truth by officials about how many people are getting sick or dying from the vaccines.

What is true of Ontario is true of everywhere.

They KNEW – and still did it

The authorities knew what was going to happen with multiple deaths and adverse reactions. The UK government's Gates-funded

and Big Pharma-dominated Medicines and Healthcare products Regulatory Agency (MHRA) hired a company to employ AI in compiling the projected reactions to the 'vaccine' that would otherwise be uncountable. The request for applications said: 'The MHRA urgently seeks an Artificial Intelligence (AI) software tool to process the expected high volume of Covid-19 vaccine Adverse Drug Reaction …' This was from the agency, headed by the disingenuous June Raine, that gave the 'vaccines' emergency approval and the company was hired before the first shot was given. 'We are going to kill and maim you – is that okay?' 'Oh, yes, perfectly fine – I'm very grateful, thank you, doctor.' The range of 'Covid vaccine' adverse reactions goes on for page after page in the MHRA criminally underreported 'Yellow Card' system and includes affects to eyes, ears, skin, digestion, blood and so on. Raine's MHRA amazingly claimed that the 'overall safety experience … is so far as expected from the clinical trials'. The death, serious adverse effects, deafness and blindness were *expected?* When did they ever mention that? If these human tragedies were expected then those that gave approval for the use of these 'vaccines' must be guilty of crimes against humanity including murder – a definition of which is 'killing a person with malice aforethought or with recklessness manifesting extreme indifference to the value of human life.' People involved at the MHRA, the CDC in America and their equivalent around the world must go before Nuremberg trials to answer for their callous inhumanity. We are only talking here about the immediate effects of the 'vaccine'. The longer-term impact of the DNA synthetic manipulation is the main reason they are so hysterically desperate to inoculate the entire global population in the shortest possible time.

Africa and the developing world are a major focus for the 'vaccine' depopulation agenda and a mass vaccination sales-pitch is underway thanks to caring people like the Rockefellers and other Cult assets. The Rockefeller Foundation, which pre-empted the 'Covid pandemic' in a document published in 2010 that 'predicted' what happened a decade later, announced an initial $34.95 million grant in February, 2021, 'to ensure more equitable access to Covid-19

testing and vaccines' among other things in Africa in collaboration with '24 organizations, businesses, and government agencies'. The pan-Africa initiative would focus on 10 countries: Burkina Faso, Ethiopia, Ghana, Kenya, Nigeria, Rwanda, South Africa, Tanzania, Uganda, and Zambia'. Rajiv Shah, President of the Rockefeller Foundation and former administrator of CIA-controlled USAID, said that if Africa was not mass-vaccinated (to change the DNA of its people) it was a 'threat to all of humanity' and not fair on Africans. When someone from the Rockefeller Foundation says they want to do something to help poor and deprived people and countries it is time for a belly-laugh. They are doing this out of the goodness of their 'heart' because 'vaccinating' the entire global population is what the 'Covid' hoax set out to achieve. Official 'decolonisation' of Africa by the Cult was merely a prelude to financial colonisation on the road to a return to physical colonisation. The 'vaccine' is vital to that and the sudden and convenient death of the 'Covid' sceptic president of Tanzania can be seen in its true light. A lot of people in Africa are aware that this is another form of colonisation and exploitation and they need to stand their ground.

The 'vaccine is working' scam

A potential problem for the Cult was that the 'vaccine' is meant to change human DNA and body messaging and not to protect anyone from a 'virus' never shown to exist. The vaccine couldn't work because it was not designed to work and how could they make it *appear* to be working so that more people would have it? This was overcome by lowering the amplification rate of the PCR test to produce fewer 'cases' and therefore fewer 'deaths'. Some of us had been pointing out since March, 2020, that the amplification rate of the test not testing for the 'virus' had been made artificially high to generate positive tests which they could call 'cases' to justify lockdowns. The World Health Organization recommended an absurdly high 45 amplification cycles to ensure the high positives required by the Cult and then remained silent on the issue until January 20th, 2021 – Biden's Inauguration Day. This was when the

'vaccinations' were seriously underway and on that day the WHO recommended after discussions with America's CDC that laboratories *lowered their testing amplification*. Dr David Samadi, a certified urologist and health writer, said the WHO was encouraging all labs to reduce their cycle count for PCR tests. He said the current cycle was much too high and was 'resulting in any particle being declared a positive case'. Even one mainstream news report I saw said this meant the number of 'Covid' infections may have been 'dramatically inflated'. Oh, just a little bit. The CDC in America issued new guidance to laboratories in April, 2021, to use 28 cycles *but only for 'vaccinated' people*. The timing of the CDC/WHO interventions were cynically designed to make it appear the 'vaccines' were responsible for falling cases and deaths when the real reason can be seen in the following examples. New York's state lab, the Wadsworth Center, identified 872 positive tests in July, 2020, based on a threshold of 40 cycles. When the figure was lowered to 35 cycles *43 percent* of the 872 were no longer 'positives'. At 30 cycles the figure was 63 percent. A Massachusetts lab found that between *85 to 90 percent* of people who tested positive in July with a cycle threshold of 40 would be negative at 30 cycles, Ashish Jha, MD, director of the Harvard Global Health Institute, said: 'I'm really shocked that it could be that high … Boy, does it really change the way we need to be thinking about testing.' I'm shocked that I could see the obvious in the spring of 2020, with no medical background, and most medical professionals still haven't worked it out. No, that's not shocking – it's terrifying.

Three weeks after the WHO directive to lower PCR cycles the London *Daily Mail* ran this headline: 'Why ARE Covid cases plummeting? New infections have fallen 45% in the US and 30% globally in the past 3 weeks but experts say vaccine is NOT the main driver because only 8% of Americans and 13% of people worldwide have received their first dose.' They acknowledged that the drop could not be attributed to the 'vaccine', but soon this morphed throughout the media into the 'vaccine' has caused cases and deaths to fall when it was the PCR threshold. In December, 2020, there was

chaos at English Channel ports with truck drivers needing negative 'Covid' tests before they could board a ferry home for Christmas. The government wanted to remove the backlog as fast as possible and they brought in troops to do the 'testing'. Out of 1,600 drivers just *36* tested positive and the rest were given the all clear to cross the Channel. I guess the authorities thought that 36 was the least they could get away with without the unquestioning catching on. The amplification trick which most people believed in the absence of information in the mainstream applied more pressure on those refusing the 'vaccine' to succumb when it 'obviously worked'. The truth was the exact opposite with deaths in care homes soaring with the 'vaccine' and in Israel the term used was 'skyrocket'. A re-analysis of published data from the Israeli Health Ministry led by Dr Hervé Seligmann at the Medicine Emerging Infectious and Tropical Diseases at Aix-Marseille University found that Pfizer's 'Covid vaccine' killed 'about 40 times more [elderly] people than the disease itself would have killed' during a five-week vaccination period and *260 times* more younger people than would have died from the 'virus' even according to the manipulated 'virus' figures. Dr Seligmann and his co-study author, Haim Yativ, declared after reviewing the Israeli 'vaccine' death data: 'This is a new Holocaust.'

Then, in mid-April, 2021, after vast numbers of people worldwide had been 'vaccinated', the story changed with clear coordination. The UK government began to prepare the ground for more future lockdowns when Nuremberg-destined Boris Johnson told yet another whopper. He said that cases had fallen because of *lockdowns* not 'vaccines'. Lockdowns are irrelevant when *there is no 'virus'* and the test and fraudulent death certificates are deciding the number of 'cases' and 'deaths'. Study after study has shown that lockdowns don't work and instead kill and psychologically destroy people. Meanwhile in the United States Anthony Fauci and Rochelle Walensky, the ultra-Zionist head of the CDC, peddled the same line. More lockdown was the answer and not the 'vaccine', a line repeated on cue by the moron that is Canadian Prime Minister Justin Trudeau. Why all the hysteria to get everyone 'vaccinated' if lockdowns and

not 'vaccines' made the difference? None of it makes sense on the face of it. Oh, but it does. The Cult wants lockdowns *and* the 'vaccine' and if the 'vaccine' is allowed to be seen as the total answer lockdowns would no longer be justified when there are still livelihoods to destroy. 'Variants' and renewed upward manipulation of PCR amplification are planned to instigate never-ending lockdown *and* more 'vaccines'.

You *must* have it – we're desperate

Israel, where the Jewish and Arab population are ruled by the Sabbatian Cult, was the front-runner in imposing the DNA-manipulating 'vaccine' on its people to such an extent that Jewish refusers began to liken what was happening to the early years of Nazi Germany. This would seem to be a fantastic claim. Why would a government of Jewish people be acting like the Nazis did? If you realise that the Sabbatian Cult was behind the Nazis and that Sabbatians hate Jews the pieces start to fit and the question of why a 'Jewish' government would treat Jews with such callous disregard for their lives and freedom finds an answer. Those controlling the government of Israel *aren't Jewish* – they're Sabbatian. Israeli lawyer Tamir Turgal was one who made the Nazi comparison in comments to German lawyer Reiner Fuellmich who is leading a class action lawsuit against the psychopaths for crimes against humanity. Turgal described how the Israeli government was vaccinating children and pregnant women on the basis that there was no evidence that this was dangerous when they had no evidence that it *wasn't* dangerous either. They just had no evidence. This was medical experimentation and Turgal said this breached the Nuremberg Code about medical experimentation and procedures requiring informed consent and choice. Think about that. A Nuremberg Code developed because of Nazi experimentation on Jews and others in concentration camps by people like the evil-beyond-belief Josef Mengele is being breached by the *Israeli* government; but when you know that it's a *Sabbatian* government along with its intelligence and military agencies like Mossad, Shin Bet and the Israeli Defense Forces, and that Sabbatians

were the force behind the Nazis, the kaleidoscope comes into focus. What have we come to when Israeli Jews are suing their government for violating the Nuremberg Code by essentially making Israelis subject to a medical experiment using the controversial 'vaccines'? It's a shocker that this has to be done in the light of what happened in Nazi Germany. The Anshe Ha-Emet, or 'People of the Truth', made up of Israeli doctors, lawyers, campaigners and public, have launched a lawsuit with the International Criminal Court. It says:

> When the heads of the Ministry of Health as well as the prime minister presented the vaccine in Israel and began the vaccination of Israeli residents, the vaccinated were not advised, that, in practice, they are taking part in a medical experiment and that their consent is required for this under the Nuremberg Code.

The irony is unbelievable, but easily explained in one word: Sabbatians. The foundation of Israeli 'Covid' apartheid is the 'green pass' or 'green passport' which allows Jews and Arabs who have had the DNA-manipulating 'vaccine' to go about their lives – to work, fly, travel in general, go to shopping malls, bars, restaurants, hotels, concerts, gyms, swimming pools, theatres and sports venues, while non-'vaccinated' are banned from all those places and activities. Israelis have likened the 'green pass' to the yellow stars that Jews in Nazi Germany were forced to wear – the same as the yellow stickers that a branch of UK supermarket chain Morrisons told exempt mask-wears they had to display when shopping. How very sensitive. The Israeli system is blatant South African-style apartheid on the basis of compliance or non-compliance to fascism rather than colour of the skin. How appropriate that the Sabbatian Israeli government was so close to the pre-Mandela apartheid regime in Pretoria. The Sabbatian-instigated 'vaccine passport' in Israel is planned for everywhere. Sabbatians struck a deal with Pfizer that allowed them to lead the way in the percentage of a national population infused with synthetic material and the result was catastrophic. Israeli freedom activist Shai Dannon told me how chairs were appearing on beaches that said 'vaccinated only'. Health Minister Yuli Edelstein said that anyone unwilling or unable to get

the jabs that 'confer immunity' will be 'left behind'. The man's a liar. Not even the makers claim the 'vaccines' confer immunity. When you see those figures of 'vaccine' deaths these psychopaths were saying that you must take the chance the 'vaccine' will kill you or maim you while knowing it will change your DNA or lockdown for you will be permanent. That's fascism. The Israeli parliament passed a law to allow personal information of the non-vaccinated to be shared with local and national authorities for three months. This was claimed by its supporters to be a way to 'encourage' people to be vaccinated. Hadas Ziv from Physicians for Human Rights described this as a 'draconian law which crushed medical ethics and the patient rights'. But that's the idea, the Sabbatians would reply.

Your papers, please

Sabbatian Israel was leading what has been planned all along to be a global 'vaccine pass' called a 'green passport' without which you would remain in permanent lockdown restriction and unable to do anything. This is how badly – *desperately* – the Cult is to get everyone 'vaccinated'. The term and colour 'green' was not by chance and related to the psychology of fusing the perception of the green climate hoax with the 'Covid' hoax and how the 'solution' to both is the same Great Reset. Lying politicians, health officials and psychologists denied there were any plans for mandatory vaccinations or restrictions based on vaccinations, but they knew that was exactly what was meant to happen with governments of all countries reaching agreements to enforce a global system. 'Free' Denmark and 'free' Sweden unveiled digital vaccine certification. Cyprus, Czech Republic, Estonia, Greece, Hungary, Iceland, Italy, Poland, Portugal, Slovakia, and Spain have all committed to a vaccine passport system and the rest including the whole of the EU would follow. The satanic UK government will certainly go this way despite mendacious denials and at the time of writing it is trying to manipulate the public into having the 'vaccine' so they could go abroad on a summer holiday. How would that work without something to prove you had the synthetic toxicity injected into you?

Documents show that the EU's European Commission was moving towards 'vaccine certificates' in 2018 and 2019 before the 'Covid' hoax began. They knew what was coming. Abracadabra – Ursula von der Leyen, the German President of the Commission, announced in March, 2021, an EU 'Digital Green Certificate' – green again – to track the public's 'Covid status'. The passport sting is worldwide and the Far East followed the same pattern with South Korea ruling that only those with 'vaccination' passports – again the *green* pass – would be able to 'return to their daily lives'.

Bill Gates has been preparing for this 'passport' with other Cult operatives for years and beyond the paper version is a Gates-funded 'digital tattoo' to identify who has been vaccinated and who hasn't. The 'tattoo' is reported to include a substance which is externally readable to confirm who has been vaccinated. This is a bio-luminous light-generating enzyme (think fireflies) called … *Luciferase*. Yes, named after the Cult 'god' Lucifer the 'light bringer' of whom more to come. Gates said he funded the readable tattoo to ensure children in the developing world were vaccinated and no one was missed out. He cares so much about poor kids as we know. This was just the cover story to develop a vaccine tagging system for everyone on the planet. Gates has been funding the ID2020 'alliance' to do just that in league with other lovely people at Microsoft, GAVI, the Rockefeller Foundation, Accenture and IDEO.org. He said in interviews in March, 2020, before any 'vaccine' publicly existed, that the world must have a globalised digital certificate to track the 'virus' and who had been vaccinated. Gates knew from the start that the mRNA vaccines were coming and when they would come and that the plan was to tag the 'vaccinated' to marginalise the intelligent and stop them doing anything including travel. Evil just doesn't suffice. Gates was exposed for offering a $10 million bribe to the Nigerian House of Representatives to invoke compulsory 'Covid' vaccination of all Nigerians. Sara Cunial, a member of the Italian Parliament, called Gates a 'vaccine criminal'. She urged the Italian President to hand him over to the International Criminal Court for crimes against

humanity and condemned his plans to 'chip the human race' through ID2020.

You know it's a long-planned agenda when war criminal and Cult gofer Tony Blair is on the case. With the scale of arrogance only someone as dark as Blair can muster he said: 'Vaccination in the end is going to be your route to liberty.' Blair is a disgusting piece of work and he confirms that again. The media has given a lot of coverage to a bloke called Charlie Mullins, founder of London's biggest independent plumbing company, Pimlico Plumbers, who has said he won't employ anyone who has not been vaccinated or have them go to any home where people are not vaccinated. He said that if he had his way no one would be allowed to walk the streets if they have not been vaccinated. Gates was cheering at the time while I was alerting the white coats. The plan is that people will qualify for 'passports' for having the first two doses and then to keep it they will have to have all the follow ups and new ones for invented 'variants' until human genetics is transformed and many are dead who can't adjust to the changes. Hollywood celebrities – the usual propaganda stunt – are promoting something called the WELL Health-Safety Rating to verify that a building or space has 'taken the necessary steps to prioritize the health and safety of their staff, visitors and other stakeholders'. They included Lady Gaga, Jennifer Lopez, Michael B. Jordan, Robert DeNiro, Venus Williams, Wolfgang Puck, Deepak Chopra and 17th Surgeon General Richard Carmona. Yawn. WELL Health-Safety has big connections with China. Parent company Delos is headed by former Goldman Sachs partner Paul Scialla. This is another example – and we will see so many others – of using the excuse of 'health' to dictate the lives and activities of the population. I guess one confirmation of the 'safety' of buildings is that only 'vaccinated' people can go in, right?

Electronic concentration camps

I wrote decades ago about the plans to restrict travel and here we are for those who refuse to bow to tyranny. This can be achieved in one go with air travel if the aviation industry makes a blanket decree.

The ‘vaccine’ and guaranteed income are designed to be part of a global version of China’s social credit system which tracks behaviour 24/7 and awards or deletes ‘credits’ based on whether your behaviour is supported by the state or not. I mean your entire lifestyle – what you do, eat, say, everything. Once your credit score falls below a certain level consequences kick in. In China tens of millions have been denied travel by air and train because of this. All the locations and activities denied to refusers by the ‘vaccine’ passports will be included in one big mass ban on doing almost anything for those that don’t bow their head to government. It’s beyond fascist and a new term is required to describe its extremes – I guess fascist technocracy will have to do. The way the Chinese system of technological – technocratic – control is sweeping the West can be seen in the Los Angeles school system and is planned to be expanded worldwide. Every child is required to have a ‘Covid’-tracking app scanned daily before they can enter the classroom. The so-called Daily Pass tracking system is produced by Gates’ Microsoft which I’m sure will shock you rigid. The pass will be scanned using a barcode (one step from an inside-the-body barcode) and the information will include health checks, ‘Covid’ tests and vaccinations. Entry codes are for one specific building only and access will only be allowed if a student or teacher has a negative test with a test not testing for the ‘virus’, has no symptoms of anything alleged to be related to ‘Covid’ (symptoms from a range of other illness), and has a temperature under 100 degrees. No barcode, no entry, is planned to be the case for everywhere and not only schools.

Kids are being psychologically prepared to accept this as ‘normal’ their whole life which is why what they can impose in schools is so important to the Cult and its gofers. Long-time American freedom campaigner John Whitehead of the Rutherford Institute was not exaggerating when he said: ‘Databit by databit, we are building our own electronic concentration camps.’ Canada under its Cult gofer prime minister Justin Trudeau has taken a major step towards the real thing with people interned against their will if they test positive with a test not testing for the ‘virus’ when they arrive at a Canadian

airport. They are jailed in internment hotels often without food or water for long periods and with many doors failing to lock there have been sexual assaults. The interned are being charged sometimes $2,000 for the privilege of being abused in this way. Trudeau is fully on board with the Cult and says the 'Covid pandemic' has provided an opportunity for a global 'reset' to permanently change Western civilisation. His number two, Deputy Prime Minister Chrystia Freeland, is a trustee of the World Economic Forum and a Rhodes Scholar. The Trudeau family have long been servants of the Cult. See *The Biggest Secret* and Cathy O'Brien's book *Trance-Formation of America* for the horrific background to Trudeau's father Pierre Trudeau another Canadian prime minister. Hide your fascism behind the façade of a heart-on-the-sleeve liberal. It's a well-honed Cult technique.

What can the 'vaccine' *really* do?

We have a 'virus' never shown to exist and 'variants' of the 'virus' that have also never been shown to exist except, like the 'original', as computer-generated fictions. Even if you believe there's a 'virus' the 'case' to 'death' rate is in the region of 0.23 to 0.15 percent and those 'deaths' are concentrated among the very old around the same average age that people die anyway. In response to this lack of threat (in truth none) psychopaths and idiots, knowingly and unknowingly answering to Gates and the Cult, are seeking to 'vaccinate' every man, woman and child on Planet Earth. Clearly the 'vaccine' is not about 'Covid' – none of this ever has been. So what is it all about *really*? Why the desperation to infuse genetically-manipulating synthetic material into everyone through mRNA fraudulent 'vaccines' with the intent of doing this over and over with the excuses of 'variants' and other 'virus' inventions? Dr Sherri Tenpenny, an osteopathic medical doctor in the United States, has made herself an expert on vaccines and their effects as a vehement campaigner against their use. Tenpenny was board certified in emergency medicine, the director of a level two trauma centre for 12 years, and moved to Cleveland in 1996 to start an integrative

medicine practice which has treated patients from all 50 states and some 17 other countries. Weaning people off pharmaceutical drugs is a speciality.

She became interested in the consequences of vaccines after attending a meeting at the National Vaccine Information Center in Washington DC in 2000 where she 'sat through four days of listening to medical doctors and scientists and lawyers and parents of vaccine injured kids' and asked: 'What's going on?' She had never been vaccinated and never got ill while her father was given a list of vaccines to be in the military and was 'sick his entire life'. The experience added to her questions and she began to examine vaccine documents from the Centers for Disease Control (CDC). After reading the first one, the 1998 version of *The General Recommendations of Vaccination*, she thought: 'This is it?' The document was poorly written and bad science and Tenpenny began 20 years of research into vaccines that continues to this day. She began her research into 'Covid vaccines' in March, 2020, and she describes them as 'deadly'. For many, as we have seen, they already have been. Tenpenny said that in the first 30 days of the 'vaccine' rollout in the United States there had been more than 40,000 adverse events reported to the vaccine adverse event database. A document had been delivered to her the day before that was 172 pages long. 'We have over 40,000 adverse events; we have over 3,100 cases of [potentially deadly] anaphylactic shock; we have over 5,000 neurological reactions.' Effects ranged from headaches to numbness, dizziness and vertigo, to losing feeling in hands or feet and paraesthesia which is when limbs 'fall asleep' and people have the sensation of insects crawling underneath their skin. All this happened in the first 30 days and remember that only about *ten percent* (or far less) of adverse reactions and vaccine-related deaths are estimated to be officially reported. Tenpenny said:

> So can you think of one single product in any industry, any industry, for as long as products have been made on the planet that within 30 days we have 40,000 people complaining of side effects that not only is still on the market but … we've got paid actors telling us how great

they are for getting their vaccine. We're offering people $500 if they will just get their vaccine and we've got nurses and doctors going; 'I got the vaccine, I got the vaccine'.

Tenpenny said they were not going to be 'happy dancing folks' when they began to suffer Bell's palsy (facial paralysis), neuropathies, cardiac arrhythmias and autoimmune reactions that kill through a blood disorder. 'They're not going to be so happy, happy then, but we're never going to see pictures of those people' she said. Tenpenny described the 'vaccine' as 'a well-designed killing tool'.

No off-switch

Bad as the initial consequences had been Tenpenny said it would be maybe 14 months before we began to see the 'full ravage' of what is going to happen to the 'Covid vaccinated' with full-out consequences taking anything between two years and 20 years to show. You can understand why when you consider that variations of the 'Covid vaccine' use mRNA (messenger RNA) to in theory activate the immune system to produce protective antibodies without using the actual 'virus'. How can they when it's a computer program and they've never isolated what they claim is the 'real thing'? Instead they use *synthetic* mRNA. They are inoculating synthetic material into the body which through a technique known as the Trojan horse is absorbed into cells to change the nature of DNA. Human DNA is changed by an infusion of messenger RNA and with each new 'vaccine' of this type it is changed even more. Say so and you are banned by Cult Internet platforms. The contempt the contemptuous Mark Zuckerberg has for the truth and human health can be seen in an internal Facebook video leaked to the Project Veritas investigative team in which he said of the 'Covid vaccines': '… I share some caution on this because we just don't know the long term side-effects of basically modifying people's DNA and RNA.' At the same time this disgusting man's Facebook was censoring and banning anyone saying exactly the same. He must go before a Nuremberg trial for crimes against humanity when he *knows* that he

is censoring legitimate concerns and denying the right of informed consent on behalf of the Cult that owns him. People have been killed and damaged by the very 'vaccination' technique he cast doubt on himself when they may not have had the 'vaccine' with access to information that he denied them. The plan is to have at least annual 'Covid vaccinations', add others to deal with invented 'variants', and change all other vaccines into the mRNA system. Pfizer executives told shareholders at a virtual Barclays Global Healthcare Conference in March, 2021, that the public may need a third dose of 'Covid vaccine', plus regular yearly boosters and the company planned to hike prices to milk the profits in a 'significant opportunity for our vaccine'. These are the professional liars, cheats and opportunists who are telling you their 'vaccine' is safe. Given this volume of mRNA planned to be infused into the human body and its ability to then replicate we will have a transformation of human genetics from biological to synthetic biological – exactly the long-time Cult plan for reasons we'll see – and many will die. Sherri Tenpenny said of this replication:

> It's like having an on-button but no off-button and that whole mechanism … they actually give it a name and they call it the Trojan horse mechanism, because it allows that [synthetic] virus and that piece of that [synthetic] virus to get inside of your cells, start to replicate and even get inserted into other parts of your DNA as a Trojan-horse.

Ask the overwhelming majority of people who have the 'vaccine' what they know about the contents and what they do and they would reply: 'The government says it will stop me getting the virus.' Governments give that false impression on purpose to increase take-up. You can read Sherri Tenpenny's detailed analysis of the health consequences in her blog at Vaxxter.com, but in summary these are some of them. She highlights the statement by Bill Gates about how human beings can become their own 'vaccine manufacturing machine'. The man is insane. ['Vaccine'-generated] 'antibodies' carry synthetic messenger RNA into the cells and the damage starts, Tenpenny contends, and she says that lungs can be adversely affected through varying degrees of pus and bleeding which

obviously affects breathing and would be dubbed 'Covid-19'. Even more sinister was the impact of 'antibodies' on macrophages, a white blood cell of the immune system. They consist of Type 1 and Type 2 which have very different functions. She said Type 1 are 'hyper-vigilant' white blood cells which 'gobble up' bacteria etc. However, in doing so, this could cause inflammation and in extreme circumstances be fatal. She says these affects are mitigated by Type 2 macrophages which kick in to calm down the system and stop it going rogue. They clear up dead tissue debris and reduce inflammation that the Type 1 'fire crews' have caused. Type 1 kills the infection and Type 2 heals the damage, she says. This is her punchline with regard to 'Covid vaccinations': She says that mRNA 'antibodies' block Type 2 macrophages by attaching to them and deactivating them. This meant that when the Type 1 response was triggered by infection there was nothing to stop that getting out of hand by calming everything down. There's an on-switch, but no off-switch, she says. What follows can be 'over and out, see you when I see you'.

Genetic suicide

Tenpenny also highlights the potential for autoimmune disease – the body attacking itself – which has been associated with vaccines since they first appeared. Infusing a synthetic foreign substance into cells could cause the immune system to react in a panic believing that the body is being overwhelmed by an invader (it is) and the consequences can again be fatal. There is an autoimmune response known as a 'cytokine storm' which I have likened to a homeowner panicked by an intruder and picking up a gun to shoot randomly in all directions before turning the fire on himself. The immune system unleashes a storm of inflammatory response called cytokines to a threat and the body commits hara-kiri. The lesson is that you mess with the body's immune response at your peril and these 'vaccines' seriously – fundamentally – mess with immune response. Tenpenny refers to a consequence called anaphylactic shock which is a severe and highly dangerous allergic reaction when the immune system

floods the body with chemicals. She gives the example of having a bee sting which primes the immune system and makes it sensitive to those chemicals. When people are stung again maybe years later the immune response can be so powerful that it leads to anaphylactic shock. Tenpenny relates this 'shock' with regard to the 'Covid vaccine' to something called polyethylene glycol or PEG. Enormous numbers of people have become sensitive to this over decades of use in a whole range of products and processes including food, drink, skin creams and 'medicine'. Studies have claimed that some 72 percent of people have antibodies triggered by PEG compared with two percent in the 1960s and allergic hypersensitive reactions to this become a gathering cause for concern. Tenpenny points out that the 'mRNA vaccine' is coated in a 'bubble' of polyethylene glycol which has the potential to cause anaphylactic shock through immune sensitivity. Many reports have appeared of people reacting this way after having the 'Covid vaccine'. What do we think is going to happen as humanity has more and more of these 'vaccines'? Tenpenny said: 'All these pictures we have seen with people with these rashes … these weepy rashes, big reactions on their arms and things like that – it's an acute allergic reaction most likely to the polyethylene glycol that you've been previously primed and sensitised to.'

Those who have not studied the conspiracy and its perpetrators at length might think that making the population sensitive to PEG and then putting it in these 'vaccines' is just a coincidence. It is not. It is instead testament to how carefully and coldly-planned current events have been and the scale of the conspiracy we are dealing with. Tenpenny further explains that the 'vaccine' mRNA procedure can breach the blood-brain barrier which protects the brain from toxins and other crap that will cause malfunction. In this case they could make two proteins corrupt brain function to cause Amyotrophic lateral sclerosis (ALS) , a progressive nervous system disease leading to loss of muscle control, and frontal lobe degeneration – Alzheimer's and dementia. Immunologist J. Bart Classon published a paper connecting mRNA 'vaccines' to prion

disease which can lead to Alzheimer's and other forms of neurogenerative disease while others have pointed out the potential to affect the placenta in ways that make women infertile. This will become highly significant in the next chapter when I will discuss other aspects of this non-vaccine that relate to its nanotechnology and transmission from the injected to the uninjected.

Qualified in idiocy

Tenpenny describes how research has confirmed that these 'vaccine'-generated antibodies can interact with a range of other tissues in the body and attack many other organs including the lungs. 'This means that if you have a hundred people standing in front of you that all got this shot they could have a hundred different symptoms.' Anyone really think that Cult gofers like the Queen, Tony Blair, Christopher Whitty, Anthony Fauci, and all the other psychopaths have really had this 'vaccine' in the pictures we've seen? Not a bloody chance. Why don't doctors all tell us about all these dangers and consequences of the 'Covid vaccine'? Why instead do they encourage and pressure patients to have the shot? Don't let's think for a moment that doctors and medical staff can't be stupid, lazy, and psychopathic and that's without the financial incentives to give the jab. Tenpenny again:

> Some people are going to die from the vaccine directly but a large number of people are going to start to get horribly sick and get all kinds of autoimmune diseases 42 days to maybe a year out. What are they going to do, these stupid doctors who say; 'Good for you for getting that vaccine.' What are they going to say; 'Oh, it must be a mutant, we need to give an extra dose of that vaccine.'
>
> Because now the vaccine, instead of one dose or two doses we need three or four because the stupid physicians aren't taking the time to learn anything about it. If I can learn this sitting in my living room reading a 19 page paper and several others so can they. There's nothing special about me, I just take the time to do it.

Remember how Sara Kayat, the NHS and TV doctor, said that the 'Covid vaccine' would '100 percent prevent hospitalisation and death'. Doctors can be idiots like every other profession and they

should not be worshipped as infallible. They are not and far from it. Behind many medical and scientific 'experts' lies an uninformed prat trying to hide themselves from you although in the 'Covid' era many have failed to do so as with UK narrative-repeating 'TV doctor' Hilary Jones. Pushing back against the minority of proper doctors and scientists speaking out against the 'vaccine' has been the entire edifice of the Cult global state in the form of governments, medical systems, corporations, mainstream media, Silicon Valley, and an army of compliant doctors, medical staff and scientists willing to say anything for money and to enhance their careers by promoting the party line. If you do that you are an 'expert' and if you won't you are an 'anti-vaxxer' and 'Covidiot'. The pressure to be 'vaccinated' is incessant. We have even had reports claiming that the 'vaccine' can help cure cancer and Alzheimer's and make the lame walk. I am waiting for the announcement that it can bring you coffee in the morning and cook your tea. Just as the symptoms of 'Covid' seem to increase by the week so have the miracles of the 'vaccine'. American supermarket giant Kroger Co. offered nearly 500,000 employees in 35 states a $100 bonus for having the 'vaccine' while donut chain Krispy Kreme promised 'vaccinated' customers a free glazed donut every day for the rest of 2021. Have your DNA changed and you will get a doughnut although we might not have to give you them for long. Such offers and incentives confirm the desperation.

Perhaps the worse vaccine-stunt of them all was UK 'Health' Secretary Matt-the-prat Hancock on live TV after watching a clip of someone being 'vaccinated' when the roll-out began. Hancock faked tears so badly it was embarrassing. Brain-of-Britain Piers Morgan, the lockdown-supporting, 'vaccine' supporting, 'vaccine' passport-supporting, TV host played along with Hancock – 'You're quite emotional about that' he said in response to acting so atrocious it would have been called out at a school nativity which will presumably today include Mary and Jesus in masks, wise men keeping their camels six feet apart, and shepherds under tent arrest. System-serving Morgan tweeted this: 'Love the idea of covid vaccine passports for everywhere: flights, restaurants, clubs, football, gyms,

shops etc. It's time covid-denying, anti-vaxxer loonies had their bullsh*t bluff called & bar themselves from going anywhere that responsible citizens go.' If only I could aspire to his genius. To think that Morgan, who specialises in shouting over anyone he disagrees with, was lauded as a free speech hero when he lost his job after storming off the set of his live show like a child throwing his dolly out of the pram. If he is a free speech hero we are in real trouble. I have no idea what 'bullsh*t' means, by the way, the * throws me completely.

The Cult is desperate to infuse its synthetic DNA-changing concoction into everyone and has been using every lie, trick and intimidation to do so. The question of '*Why*?' we shall now address.

CHAPTER TEN

Human 2.0

I believe that at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted –
Alan Turing (1912-1954), the 'Father of artificial intelligence'

I have been exposing for decades the plan to transform the human body from a biological to a synthetic-biological state. The new human that I will call Human 2.0 is planned to be connected to artificial intelligence and a global AI 'Smart Grid' that would operate as one global system in which AI would control everything from your fridge to your heating system to your car to your mind. Humans would no longer be 'human', but post-human and sub-human, with their thinking and emotional processes replaced by AI.

What I said sounded crazy and beyond science fiction and I could understand that. To any balanced, rational, mind it *is* crazy. Today, however, that world is becoming reality and it puts the 'Covid vaccine' into its true context. Ray Kurzweil is the ultra-Zionist 'computer scientist, inventor and futurist' and co-founder of the Singularity University. Singularity refers to the merging of humans with machines or 'transhumanism'. Kurzweil has said humanity would be connected to the cyber 'cloud' in the period of the ever-recurring year of 2030:

Our thinking … will be a hybrid of biological and non-biological thinking … humans will be able to extend their limitations and 'think in the cloud' … We're going to put gateways to the

cloud in our brains ... We're going to gradually merge and enhance ourselves ... In my view, that's the nature of being human – we transcend our limitations. As the technology becomes vastly superior to what we are then the small proportion that is still human gets smaller and smaller and smaller until it's just utterly negligible.

They are trying to sell this end-of-humanity-as-we-know-it as the next stage of 'evolution' when we become super-human and 'like the gods'. They are lying to you. Shocked, eh? The population, and again especially the young, have been manipulated into addiction to technologies designed to enslave them for life. First they induced an addiction to smartphones (holdables); next they moved to technology on the body (wearables); and then began the invasion of the body (implantables). I warned way back about the plan for microchipped people and we are now entering that era. We should not be diverted into thinking that this refers only to chips we can see. Most important are the nanochips known as smart dust, neural dust and nanobots which are far too small to be seen by the human eye. Nanotechnology is everywhere, increasingly in food products, and released into the atmosphere by the geoengineering of the skies funded by Bill Gates to 'shut out the Sun' and 'save the planet from global warming'. Gates has been funding a project to spray millions of tonnes of chalk (calcium carbonate) into the stratosphere over Sweden to 'dim the Sun' and cool the Earth. Scientists warned the move could be disastrous for weather systems in ways no one can predict and opposition led to the Swedish space agency announcing that the 'experiment' would not be happening as planned in the summer of 2021; but it shows where the Cult is going with dimming the impact of the Sun and there's an associated plan to change the planet's atmosphere. Who gives psychopath Gates the right to dictate to the entire human race and dismantle planetary systems? The world will not be safe while this man is at large.

The global warming hoax has made the Sun, like the gas of life, something to fear when both are essential to good health and human survival (more inversion). The body transforms sunlight into vital vitamin D through a process involving … *cholesterol*. This is the cholesterol we are also told to fear. We are urged to take Big Pharma

statin drugs to reduce cholesterol and it's all systematic. Reducing cholesterol means reducing vitamin D uptake with all the multiple health problems that will cause. At least if you take statins long term it saves the government from having to pay you a pension. The delivery system to block sunlight is widely referred to as chemtrails although these have a much deeper agenda, too. They appear at first to be contrails or condensation trails streaming from aircraft into cold air at high altitudes. Contrails disperse very quickly while chemtrails do not and spread out across the sky before eventually their content falls to earth. Many times I have watched aircraft cross-cross a clear blue sky releasing chemtrails until it looks like a cloudy day. Chemtrails contain many things harmful to humans and the natural world including toxic heavy metals, aluminium (see Alzheimer's) and nanotechnology. Ray Kurzweil reveals the reason without actually saying so: 'Nanobots will infuse all the matter around us with information. Rocks, trees, everything will become these intelligent creatures.' How do you deliver that? *From the sky*. Self-replicating nanobots would connect everything to the Smart Grid. The phenomenon of Morgellons disease began in the chemtrail era and the correlation has led to it being dubbed the 'chemtrail disease'. Self-replicating fibres appear in the body that can be pulled out through the skin. Morgellons fibres continue to grow outside the body and have a form of artificial intelligence. I cover this at greater length in *Phantom Self*.

'Vaccine' operating system

'Covid vaccines' with their self-replicating synthetic material are also designed to make the connection between humanity and Kurzweil's 'cloud'. American doctor and dedicated campaigner for truth, Carrie Madej, an Internal Medicine Specialist in Georgia with more than 20 years medical experience, has highlighted the nanotechnology aspect of the fake 'vaccines'. She explains how one of the components in at least the Moderna and Pfizer synthetic potions are 'lipid nanoparticles' which are 'like little tiny computer bits' – a 'sci-fi substance' known as nanobots and hydrogel which can be 'triggered

at any moment to deliver its payload' and act as 'biosensors'. The synthetic substance had 'the ability to accumulate data from your body like your breathing, your respiration, thoughts and emotions, all kind of things' and each syringe could carry a *million* nanobots:

This substance because it's like little bits of computers in your body, crazy, but it's true, it can do that, [and] obviously has the ability to act through Wi-Fi. It can receive and transmit energy, messages, frequencies or impulses. That issue has never been addressed by these companies. What does that do to the human?

Just imagine getting this substance in you and it can react to things all around you, the 5G, your smart device, your phones, what is happening with that? What if something is triggering it, too, like an impulse, a frequency? We have something completely foreign in the human body.

Madej said her research revealed that electromagnetic (EMF) frequencies emitted by phones and other devices had increased dramatically in the same period of the 'vaccine' rollout and she was seeing more people with radiation problems as 5G and other electromagnetic technology was expanded and introduced to schools and hospitals. She said she was 'floored with the EMF coming off' the devices she checked. All this makes total sense and syncs with my own work of decades when you think that Moderna refers in documents to its mRNA 'vaccine' as an 'operating system':

Recognizing the broad potential of mRNA science, we set out to create an mRNA technology platform that functions very much like an operating system on a computer. It is designed so that it can plug and play interchangeably with different programs. In our case, the 'program' or 'app' is our mRNA drug – the unique mRNA sequence that codes for a protein …

… Our MRNA Medicines – 'The 'Software Of Life': When we have a concept for a new mRNA medicine and begin research, fundamental components are already in place. Generally, the only thing that changes from one potential mRNA medicine to another is the coding region – the actual genetic code that instructs ribosomes to make protein. Utilizing these instruction sets gives our investigational mRNA medicines a software-like quality. We also have the ability to combine different mRNA sequences encoding for different proteins in a single mRNA investigational medicine.

Who needs a real 'virus' when you can create a computer version to justify infusing your operating system into the entire human race on the road to making living, breathing people into cyborgs? What is missed with the 'vaccines' is the *digital* connection between synthetic material and the body that I highlighted earlier with the study that hacked a computer with human DNA. On one level the body is digital, based on mathematical codes, and I'll have more about that in the next chapter. Those who ridiculously claim that mRNA 'vaccines' are not designed to change human genetics should explain the words of Dr Tal Zaks, chief medical officer at Moderna, in a 2017 TED talk. He said that over the last 30 years 'we've been living this phenomenal digital scientific revolution, and I'm here today to tell you, that we are actually *hacking the software of life*, and that it's changing the way we think about prevention and treatment of disease':

In every cell there's this thing called messenger RNA, or mRNA for short, that transmits the critical information from the DNA in our genes to the protein, which is really the stuff we're all made out of. This is the critical information that determines what the cell will do. So we think about it as an operating system. So if you could change that, if you could introduce a line of code, or change a line of code, it turns out, that has profound implications for everything, from the flu to cancer.

Zaks should more accurately have said that this has profound implications for the human genetic code and the nature of DNA. Communications within the body go both ways and not only one. But, hey, no, the 'Covid vaccine' will not affect your genetics. Cult fact-checkers say so even though the man who helped to develop the mRNA technique says that it does. Zaks said in 2017:

If you think about what it is we're trying to do. We've taken information and our understanding of that information and how that information is transmitted in a cell, and we've taken our understanding of medicine and how to make drugs, and we're fusing the two. We think of it as information therapy.

I have been writing for decades that the body is an information field communicating with itself and the wider world. This is why

radiation which is information can change the information field of body and mind through phenomena like 5G and change their nature and function. 'Information therapy' means to change the body's information field and change the way it operates. DNA is a receiver-transmitter of information and can be mutated by information like mRNA synthetic messaging. Technology to do this has been ready and waiting in the underground bases and other secret projects to be rolled out when the 'Covid' hoax was played. 'Trials' of such short and irrelevant duration were only for public consumption. When they say the 'vaccine' is 'experimental' that is not true. It may appear to be 'experimental' to those who don't know what's going on, but the trials have already been done to ensure the Cult gets the result it desires. Zaks said that it took decades to sequence the human genome, completed in 2003, but now they could do it in a week. By 'they' he means scientists operating in the public domain. In the secret projects they were sequencing the genome in a week long before even 2003.

Deluge of mRNA

Highly significantly the Moderna document says the guiding premise is that if using mRNA as a medicine works for one disease then it should work for many diseases. They were leveraging the flexibility afforded by their platform and the fundamental role mRNA plays in protein synthesis to pursue mRNA medicines for a broad spectrum of diseases. Moderna is confirming what I was saying through 2020 that multiple 'vaccines' were planned for 'Covid' (and later invented 'variants') and that previous vaccines would be converted to the mRNA system to infuse the body with massive amounts of genetically-manipulating synthetic material to secure a transformation to a synthetic-biological state. The 'vaccines' are designed to kill stunning numbers as part of the long-exposed Cult depopulation agenda and transform the rest. Given this is the goal you can appreciate why there is such hysterical demand for every human to be 'vaccinated' for an alleged 'disease' that has an estimated 'infection' to 'death' ratio of 0.23-0.15 percent. As I write

children are being given the 'vaccine' in trials (their parents are a disgrace) and ever-younger people are being offered the vaccine for a 'virus' that even if you believe it exists has virtually zero chance of harming them. Horrific effects of the 'trials' on a 12-year-old girl were revealed by a family member to be serious brain and gastric problems that included a bowel obstruction and the inability to swallow liquids or solids. She was unable to eat or drink without throwing up, had extreme pain in her back, neck and abdomen, and was paralysed from the waist down which stopped her urinating unaided. When the girl was first taken to hospital doctors said it was all in her mind. She was signed up for the 'trial' by her parents for whom no words suffice. None of this 'Covid vaccine' insanity makes any sense unless you see what the 'vaccine' really is – a body-changer. Synthetic biology or 'SynBio' is a fast-emerging and expanding scientific discipline which includes everything from genetic and molecular engineering to electrical and computer engineering. Synthetic biology is defined in these ways:

- A multidisciplinary area of research that seeks to create new biological parts, devices, and systems, or to redesign systems that are already found in nature.

- The use of a mixture of physical engineering and genetic engineering to create new (and therefore synthetic) life forms.

- An emerging field of research that aims to combine the knowledge and methods of biology, engineering and related disciplines in the design of chemically-synthesized DNA to create organisms with novel or enhanced characteristics and traits (synthetic organisms including humans).

We now have synthetic blood, skin, organs and limbs being developed along with synthetic body parts produced by 3D printers. These are all elements of the synthetic human programme and this comment by Kurzweil's co-founder of the Singularity University,

Peter Diamandis, can be seen in a whole new light with the 'Covid' hoax and the sanctions against those that refuse the 'vaccine':

Anybody who is going to be resisting the progress forward [to transhumanism] is going to be resisting evolution and, fundamentally, they will die out. It's not a matter of whether it's good or bad. It's going to happen.

'Resisting evolution'? What absolute bollocks. The arrogance of these people is without limit. His 'it's going to happen' mantra is another way of saying 'resistance is futile' to break the spirit of those pushing back and we must not fall for it. Getting this genetically-transforming 'vaccine' into everyone is crucial to the Cult plan for total control and the desperation to achieve that is clear for anyone to see. Vaccine passports are a major factor in this and they, too, are a form of resistance is futile. It's NOT. The paper funded by the Rockefeller Foundation for the 2013 'health conference' in China said:

We will interact more with artificial intelligence. The use of robotics, bio-engineering to augment human functioning is already well underway and will advance. Re-engineering of humans into potentially separate and unequal forms through genetic engineering or mixed human-robots raises debates on ethics and equality.

A new demography is projected to emerge after 2030 [that year again] of technologies (robotics, genetic engineering, nanotechnology) producing robots, engineered organisms, 'nanobots' and artificial intelligence (AI) that can self-replicate. Debates will grow on the implications of an impending reality of human designed life.

What is happening today is so long planned. The world army enforcing the will of the world government is intended to be a robot army, not a human one. Today's military and its technologically 'enhanced' troops, pilotless planes and driverless vehicles are just stepping stones to that end. Human soldiers are used as Cult fodder and its time they woke up to that and worked for the freedom of the population instead of their own destruction and their family's destruction – the same with the police. Join us and let's sort this out. The phenomenon of enforce my own destruction is widespread in the 'Covid' era with Woker 'luvvies' in the acting and entertainment

industries supporting 'Covid' rules which have destroyed their profession and the same with those among the public who put signs on the doors of their businesses 'closed due to Covid – stay safe' when many will never reopen. It's a form of masochism and most certainly insanity.

Transgender = transhumanism

When something explodes out of nowhere and is suddenly everywhere it is always the Cult agenda and so it is with the tidal wave of claims and demands that have infiltrated every aspect of society under the heading of 'transgenderism'. The term 'trans' is so 'in' and this is the dictionary definition:

A prefix meaning 'across', 'through', occurring … in loanwords from Latin, used in particular for denoting movement or conveyance from place to place (transfer; transmit; transplant) or complete change (transform; transmute), or to form adjectives meaning 'crossing', 'on the other side of', or 'going beyond' the place named (transmontane; transnational; trans-Siberian).

Transgender means to go beyond gender and transhuman means to go beyond human. Both are aspects of the Cult plan to transform the human body to a synthetic state with *no gender*. Human 2.0 is not designed to procreate and would be produced technologically with no need for parents. The new human would mean the end of parents and so men, and increasingly women, are being targeted for the deletion of their rights and status. Parental rights are disappearing at an ever-quickening speed for the same reason. The new human would have no need for men or women when there is no procreation and no gender. Perhaps the transgender movement that appears to be in a permanent state of frenzy might now contemplate on how it is being used. This was never about transgender rights which are only the interim excuse for confusing gender, particularly in the young, on the road to *fusing* gender. Transgender activism is not an end; it is a *means* to an end. We see again the technique of creative destruction in which you destroy the status quo to 'build back better' in the form that you want. The gender status quo had to be

destroyed by persuading the Cult-created Woke mentality to believe that you can have 100 genders or more. A programme for 9 to 12 year olds produced by the Cult-owned BBC promoted the 100 genders narrative. The very idea may be the most monumental nonsense, but it is not what is true that counts, only what you can make people *believe* is true. Once the gender of 2 + 2 = 4 has been dismantled through indoctrination, intimidation and 2 + 2 = 5 then the new no-gender normal can take its place with Human 2.0. Aldous Huxley revealed the plan in his prophetic *Brave New World* in 1932:

> Natural reproduction has been done away with and children are created, decanted', and raised in 'hatcheries and conditioning centres'. From birth, people are genetically designed to fit into one of five castes, which are further split into 'Plus' and 'Minus' members and designed to fulfil predetermined positions within the social and economic strata of the World State.

How could Huxley know this in 1932? For the same reason George Orwell knew about the Big Brother state in 1948, Cult insiders I have quoted knew about it in 1969, and I have known about it since the early 1990s. If you are connected to the Cult or you work your balls off to uncover the plan you can predict the future. The process is simple. If there is a plan for the world and nothing intervenes to stop it then it will happen. Thus if you communicate the plan ahead of time you are perceived to have predicted the future, but you haven't. You have revealed the plan which without intervention will become the human future. The whole reason I have done what I have is to alert enough people to inspire an intervention and maybe at last that time has come with the Cult and its intentions now so obvious to anyone with a brain in working order.

The future is here

Technological wombs that Huxley described to replace parent procreation are already being developed and they are only the projects we know about in the public arena. Israeli scientists told *The Times of Israel* in March, 2021, that they have grown 250-cell embryos

into mouse foetuses with fully formed organs using artificial wombs in a development they say could pave the way for gestating humans outside the womb. Professor Jacob Hanna of the Weizmann Institute of Science said:

We took mouse embryos from the mother at day five of development, when they are just of 250 cells, and had them in the incubator from day five until day 11, by which point they had grown all their organs.

By day 11 they make their own blood and have a beating heart, a fully developed brain. Anybody would look at them and say, 'this is clearly a mouse foetus with all the characteristics of a mouse.' It's gone from being a ball of cells to being an advanced foetus.

A special liquid is used to nourish embryo cells in a laboratory dish and they float on the liquid to duplicate the first stage of embryonic development. The incubator creates all the right conditions for its development, Hanna said. The liquid gives the embryo 'all the nutrients, hormones and sugars they need' along with a custom-made electronic incubator which controls gas concentration, pressure and temperature. The cutting-edge in the underground bases and other secret locations will be light years ahead of that, however, and this was reported by the London *Guardian* in 2017:

We are approaching a biotechnological breakthrough. Ectogenesis, the invention of a complete external womb, could completely change the nature of human reproduction. In April this year, researchers at the Children's Hospital of Philadelphia announced their development of an artificial womb.

The article was headed 'Artificial wombs could soon be a reality. What will this mean for women?' What would it mean for children is an even bigger question. No mother to bond with only a machine in preparation for a life of soulless interaction and control in a world governed by machines (see the *Matrix* movies). Now observe the calculated manipulations of the 'Covid' hoax as human interaction and warmth has been curtailed by distancing, isolation and fear with people communicating via machines on a scale never seen before.

These are all dots in the same picture as are all the personal assistants, gadgets and children's toys through which kids and adults communicate with AI as if it is human. The AI 'voice' on Sat-Nav should be included. All these things are psychological preparation for the Cult endgame. Before you can make a physical connection with AI you have to make a psychological connection and that is what people are being conditioned to do with this ever gathering human-AI interaction. Movies and TV programmes depicting the transhuman, robot dystopia relate to a phenomenon known as 'pre-emptive programming' in which the world that is planned is portrayed everywhere in movies, TV and advertising. This is conditioning the conscious and subconscious mind to become familiar with the planned reality to dilute resistance when it happens for real. What would have been a shock such is the change is made less so. We have young children put on the road to transgender transition surgery with puberty blocking drugs at an age when they could never be able to make those life-changing decisions.

Rachel Levine, a professor of paediatrics and psychiatry who believes in treating children this way, became America's highest-ranked openly-transgender official when she was confirmed as US Assistant Secretary at the Department of Health and Human Services after being nominated by Joe Biden (the Cult). Activists and governments press for laws to deny parents a say in their children's transition process so the kids can be isolated and manipulated into agreeing to irreversible medical procedures. A Canadian father Robert Hoogland was denied bail by the Vancouver Supreme Court in 2021 and remained in jail for breaching a court order that he stay silent over his young teenage daughter, a minor, who was being offered life-changing hormone therapy without parental consent. At the age of 12 the girl's 'school counsellor' said she may be transgender, referred her to a doctor and told the school to treat her like a boy. This is another example of state-serving schools imposing ever more control over children's lives while parents have ever less.

Contemptible and extreme child abuse is happening all over the world as the Cult gender-fusion operation goes into warp-speed.

Why the war on men – and now women?

The question about what artificial wombs mean for women should rightly be asked. The answer can be seen in the deletion of women's rights involving sport, changing rooms, toilets and status in favour of people in male bodies claiming to identify as women. I can identify as a mountain climber, but it doesn't mean I can climb a mountain any more than a biological man can be a biological woman. To believe so is a triumph of belief over factual reality which is the very perceptual basis of everything Woke. Women's sport is being destroyed by allowing those with male bodies who say they identify as female to 'compete' with girls and women. Male body 'women' dominate 'women's' competition with their greater muscle mass, bone density, strength and speed. With that disadvantage sport for women loses all meaning. To put this in perspective nearly 300 American high school boys can run faster than the quickest woman sprinter in the world. Women are seeing their previously protected spaces invaded by male bodies simply because they claim to identify as women. That's all they need to do to access all women's spaces and activities under the Biden 'Equality Act' that destroys equality for women with the usual Orwellian Woke inversion. Male sex offenders have already committed rapes in women's prisons after claiming to identify as women to get them transferred. Does this not matter to the Woke 'equality' hypocrites? Not in the least. What matters to Cult manipulators and funders behind transgender activists is to advance gender fusion on the way to the no-gender 'human'. When you are seeking to impose transparent nonsense like this, or the 'Covid' hoax, the only way the nonsense can prevail is through censorship and intimidation of dissenters, deletion of factual information, and programming of the unquestioning, bewildered and naive. You don't have to scan the world for long to see that all these things are happening.

Many women's rights organisations have realised that rights and status which took such a long time to secure are being eroded and that it is systematic. Kara Dansky of the global Women's Human Rights Campaign said that Biden's transgender executive order immediately he took office, subsequent orders, and Equality Act legislation that followed 'seek to erase women and girls in the law as a category'. *Exactly*. I said during the long ago-started war on men (in which many women play a crucial part) that this was going to turn into a war on them. The Cult is phasing out *both* male and female genders. To get away with that they are brought into conflict so they are busy fighting each other while the Cult completes the job with no unity of response. Unity, people, *unity*. We need unity everywhere. Transgender is the only show in town as the big step towards the no-gender human. It's not about rights for transgender people and never has been. Woke political correctness is deleting words relating to genders to the same end. Wokers believe this is to be 'inclusive' when the opposite is true. They are deleting words describing gender because gender *itself* is being deleted by Human 2.0. Terms like 'man', 'woman', 'mother' and 'father' are being deleted in the universities and other institutions to be replaced by the *no*-gender, not trans-gender, 'individuals' and 'guardians'. Women's rights campaigner Maria Keffler of Partners for Ethical Care said: 'Children are being taught from kindergarten upward that some boys have a vagina, some girls have a penis, and that kids can be any gender they want to be.' Do we really believe that suddenly countries all over the world at the same time had the idea of having drag queens go into schools or read transgender stories to very young children in the local library? It's coldly-calculated confusion of gender on the way to the fusion of gender. Suzanne Vierling, a psychologist from Southern California, made another important point:

Yesterday's slave woman who endured gynecological medical experiments is today's girl-child being butchered in a booming gender-transitioning sector. Ovaries removed, pushing her into menopause and osteoporosis, uncharted territory, and parents' rights and authority decimated.

The erosion of parental rights is a common theme in line with the Cult plans to erase the very concept of parents and 'ovaries removed, pushing her into menopause' means what? Those born female lose the ability to have children – another way to discontinue humanity as we know it.

Eliminating Human 1.0 (before our very eyes)

To pave the way for Human 2.0 you must phase out Human 1.0. This is happening through plummeting sperm counts and making women infertile through an onslaught of chemicals, radiation (including smartphones in pockets of men) and mRNA 'vaccines'. Common agriculture pesticides are also having a devastating impact on human fertility. I have been tracking collapsing sperm counts in the books for a long time and in 2021 came a book by fertility scientist and reproductive epidemiologist Shanna Swan, *Count Down: How Our Modern World Is Threatening Sperm Counts, Altering Male and Female Reproductive Development and Imperiling the Future of the Human Race*. She reports how the global fertility rate dropped by *half* between 1960 and 2016 with America's birth rate 16 percent below where it needs to be to sustain the population. Women are experiencing declining egg quality, more miscarriages, and more couples suffer from infertility. Other findings were an increase in erectile dysfunction, infant boys developing more genital abnormalities, male problems with conception, and plunging levels of the male hormone testosterone which would explain why so many men have lost their backbone and masculinity. This has been very evident during the 'Covid' hoax when women have been prominent among the Pushbackers and big strapping blokes have bowed their heads, covered their faces with a nappy and quietly submitted. Mind control expert Cathy O'Brien also points to how global education introduced the concept of 'we're all winners' in sport and classrooms: 'Competition was defused, and it in turn defused a sense of fighting back.' This is another version of the 'equity' doctrine in which you drive down rather than raise up. What a contrast in Cult-controlled China with its global ambitions

where the government published plans in January, 2021, to 'cultivate masculinity' in boys from kindergarten through to high school in the face of a 'masculinity crisis'. A government adviser said boys would be soon become 'delicate, timid and effeminate' unless action was taken. Don't expect any similar policy in the targeted West. A 2006 study showed that a 65-year-old man in 2002 had testosterone levels *15 percent* lower than a 65-year-old man in 1987 while a 2020 study found a similar story with young adults and adolescents. Men are getting prescriptions for testosterone replacement therapy which causes an even greater drop in sperm count with up to 99 percent seeing sperm counts drop to zero during the treatment. More sperm is defective and malfunctioning with some having two heads or not pursuing an egg.

A class of *synthetic* chemicals known as phthalates are being blamed for the decline. These are found everywhere in plastics, shampoos, cosmetics, furniture, flame retardants, personal care products, pesticides, canned foods and even receipts. Why till receipts? Everyone touches them. Let no one delude themselves that all this is not systematic to advance the long-time agenda for human body transformation. Phthalates mimic hormones and disrupt the hormone balance causing testosterone to fall and genital birth defects in male infants. Animals and fish have been affected in the same way due to phthalates and other toxins in rivers. When fish turn gay or change sex through chemicals in rivers and streams it is a pointer to why there has been such an increase in gay people and the sexually confused. It doesn't matter to me what sexuality people choose to be, but if it's being affected by chemical pollution and consumption then we need to know. Does anyone really think that this is not connected to the transgender agenda, the war on men and the condemnation of male 'toxic masculinity'? You watch this being followed by 'toxic femininity'. It's already happening. When breastfeeding becomes 'chest-feeding', pregnant women become pregnant people along with all the other Woke claptrap you know that the world is going insane and there's a Cult scam in progress. Transgender activists are promoting the Cult agenda while Cult

billionaires support and fund the insanity as they laugh themselves to sleep at the sheer stupidity for which humans must be infamous in galaxies far, far away.

'Covid vaccines' and female infertility

We can now see why the 'vaccine' has been connected to potential infertility in women. Dr Michael Yeadon, former Vice President and Chief Scientific Advisor at Pfizer, and Dr Wolfgang Wodarg in Germany, filed a petition with the European Medicines Agency in December, 2020, urging them to stop trials for the Pfizer/BioNTech shot and all other mRNA trials until further studies had been done. They were particularly concerned about possible effects on fertility with 'vaccine'-produced antibodies attacking the protein Syncytin-1 which is responsible for developing the placenta. The result would be infertility 'of indefinite duration' in women who have the 'vaccine' with the placenta failing to form. Section 10.4.2 of the Pfizer/BioNTech trial protocol says that pregnant women or those who might become so should not have mRNA shots. Section 10.4 warns men taking mRNA shots to 'be abstinent from heterosexual intercourse' and not to donate sperm. The UK government said that it *did not know* if the mRNA procedure had an effect on fertility. *Did not know?* These people have to go to jail. UK government advice did not recommend at the start that pregnant women had the shot and said they should avoid pregnancy for at least two months after 'vaccination'. The 'advice' was later updated to pregnant women should only have the 'vaccine' if the benefits outweighed the risks to mother and foetus. What the hell is that supposed to mean? Then 'spontaneous abortions' began to appear and rapidly increase on the adverse reaction reporting schemes which include only a fraction of adverse reactions. Thousands and ever-growing numbers of 'vaccinated' women are describing changes to their menstrual cycle with heavier blood flow, irregular periods and menstruating again after going through the menopause – all links to reproduction effects. Women are passing blood clots and the lining of their uterus while men report erectile dysfunction and blood effects. Most

significantly of all *un*vaccinated women began to report similar menstrual changes after interaction with *'vaccinated'* people and men and children were also affected with bleeding noses, blood clots and other conditions. 'Shedding' is when vaccinated people can emit the content of a vaccine to affect the unvaccinated, but this is different. 'Vaccinated' people were not shedding a 'live virus' allegedly in 'vaccines' as before because the fake 'Covid vaccines' involve synthetic material and other toxicity. Doctors exposing what is happening prefer the term 'transmission' to shedding. Somehow those that have had the shots are transmitting effects to those that haven't. Dr Carrie Madej said the nano-content of the 'vaccines' can 'act like an antenna' to others around them which fits perfectly with my own conclusions. This 'vaccine' transmission phenomenon was becoming known as the book went into production and I deal with this further in the Postscript.

Vaccine effects on sterility are well known. The World Health Organization was accused in 2014 of sterilising millions of women in Kenya with the evidence confirmed by the content of the vaccines involved. The same WHO behind the 'Covid' hoax admitted its involvement for more than ten years with the vaccine programme. Other countries made similar claims. Charges were lodged by Tanzania, Nicaragua, Mexico, and the Philippines. The Gardasil vaccine claimed to protect against a genital 'virus' known as HPV has also been linked to infertility. Big Pharma and the WHO (same thing) are criminal and satanic entities. Then there's the Bill Gates Foundation which is connected through funding and shared interests with 20 pharmaceutical giants and laboratories. He stands accused of directing the policy of United Nations Children's Fund (UNICEF), vaccine alliance GAVI, and other groupings, to advance the vaccine agenda and silence opposition at great cost to women and children. At the same time Gates wants to reduce the global population. Coincidence?

Great Reset = Smart Grid = new human

The Cult agenda I have been exposing for 30 years is now being openly promoted by Cult assets like Gates and Klaus Schwab of the World Economic Forum under code-terms like the 'Great Reset', 'Build Back Better' and 'a rare but narrow window of opportunity to reflect, reimagine, and reset our world'. What provided this 'rare but narrow window of opportunity'? The 'Covid' hoax did. Who created that? *They* did. My books from not that long ago warned about the planned 'Internet of Things' (IoT) and its implications for human freedom. This was the plan to connect all technology to the Internet and artificial intelligence and today we are way down that road with an estimated 36 billion devices connected to the World Wide Web and that figure is projected to be 76 billion by 2025. I further warned that the Cult planned to go beyond that to the Internet of *Everything* when the human brain was connected via AI to the Internet and Kurzweil's 'cloud'. Now we have Cult operatives like Schwab calling for precisely that under the term 'Internet of Bodies', a fusion of the physical, digital and biological into one centrally-controlled Smart Grid system which the Cult refers to as the 'Fourth Industrial Revolution'. They talk about the 'biological', but they really mean the synthetic-biological which is required to fully integrate the human body and brain into the Smart Grid and artificial intelligence planned to replace the human mind. We have everything being synthetically manipulated including the natural world through GMO and smart dust, the food we eat and the human body itself with synthetic 'vaccines'. I said in *The Answer* that we would see the Cult push for synthetic meat to replace animals and in February, 2021, the so predictable psychopath Bill Gates called for the introduction of synthetic meat to save us all from 'climate change'. The climate hoax just keeps on giving like the 'Covid' hoax. The war on meat by vegan activists is a carbon (oops, sorry) copy of the manipulation of transgender activists. They have no idea (except their inner core) that they are being used to promote and impose the agenda of the Cult or that they are only the *vehicle* and not the *reason*. This is not to say those who choose not to eat meat shouldn't be respected and supported in that right, but there are ulterior motives

for those in power. A *Forbes* article in December, 2019, highlighted the plan so beloved of Schwab and the Cult under the heading: 'What Is The Internet of Bodies? And How Is It Changing Our World?' The article said the human body is the latest data platform (remember 'our vaccine is an operating system'). *Forbes* described the plan very accurately and the words could have come straight out of my books from long before:

The Internet of Bodies (IoB) is an extension of the IoT and basically connects the human body to a network through devices that are ingested, implanted, or connected to the body in some way. Once connected, data can be exchanged, and the body and device can be remotely monitored and controlled.

They were really describing a human hive mind with human perception centrally-dictated via an AI connection as well as allowing people to be 'remotely monitored and controlled'. Everything from a fridge to a human mind could be directed from a central point by these insane psychopaths and 'Covid vaccines' are crucial to this. Forbes explained the process I mentioned earlier of holdable and wearable technology followed by implantable. The article said there were three generations of the Internet of Bodies that include:

- Body external: These are wearable devices such as Apple Watches or Fitbits that can monitor our health.

- Body internal: These include pacemakers, cochlear implants, and digital pills that go inside our bodies to monitor or control various aspects of health.

- Body embedded: The third generation of the Internet of Bodies is embedded technology where technology and the human body are melded together and have a real-time connection to a remote machine.

Forbes noted the development of the Brain Computer Interface (BCI) which merges the brain with an external device for monitoring and controlling in real-time. 'The ultimate goal is to help restore function to individuals with disabilities by using brain signals rather than conventional neuromuscular pathways.' Oh, do fuck off. The goal of brain interface technology is controlling human thought and emotion from the central point in a hive mind serving its masters wishes. Many people are now agreeing to be chipped to open doors without a key. You can recognise them because they'll be wearing a mask, social distancing and lining up for the 'vaccine'. The Cult plans a Great Reset money system after they have completed the demolition of the global economy in which 'money' will be exchanged through communication with body operating systems. Rand Corporation, a Cult-owned think tank, said of the Internet of Bodies or IoB:

> Internet of Bodies technologies fall under the broader IoT umbrella. But as the name suggests, IoB devices introduce an even more intimate interplay between humans and gadgets. IoB devices monitor the human body, collect health metrics and other personal information, and transmit those data over the Internet. Many devices, such as fitness trackers, are already in use … IoB devices … and those in development can track, record, and store users' whereabouts, bodily functions, and what they see, hear, and even think.

Schwab's World Economic Forum, a long-winded way of saying 'fascism' or 'the Cult', has gone full-on with the Internet of Bodies in the 'Covid' era. 'We're entering the era of the Internet of Bodies', it declared, 'collecting our physical data via a range of devices that can be implanted, swallowed or worn'. The result would be a huge amount of health-related data that could improve human wellbeing around the world, and prove crucial in fighting the 'Covid-19 pandemic'. Does anyone think these clowns care about 'human wellbeing' after the death and devastation their pandemic hoax has purposely caused? Schwab and co say we should move forward with the Internet of Bodies because 'Keeping track of symptoms could help us stop the spread of infection, and quickly detect new cases'. How wonderful, but keeping track' is all they are really bothered

about. Researchers were investigating if data gathered from smartwatches and similar devices could be used as viral infection alerts by tracking the user's heart rate and breathing. Schwab said in his 2018 book *Shaping the Future of the Fourth Industrial Revolution*:

> The lines between technologies and beings are becoming blurred and not just by the ability to create lifelike robots or synthetics. Instead it is about the ability of new technologies to literally become part of us. Technologies already influence how we understand ourselves, how we think about each other, and how we determine our realities. As the technologies … give us deeper access to parts of ourselves, we may begin to integrate digital technologies into our bodies.

You can see what the game is. Twenty-four hour control and people – if you could still call them that – would never know when something would go ping and take them out of circulation. It's the most obvious rush to a global fascist dictatorship and the complete submission of humanity and yet still so many are locked away in their Cult-induced perceptual coma and can't see it.

Smart Grid control centres

The human body is being transformed by the 'vaccines' and in other ways into a synthetic cyborg that can be attached to the global Smart Grid which would be controlled from a central point and other sub-locations of Grid manipulation. Where are these planned to be? Well, China for a start which is one of the Cult's biggest centres of operation. The technological control system and technocratic rule was incubated here to be unleashed across the world after the 'Covid' hoax came out of China in 2020. Another Smart Grid location that will surprise people new to this is Israel. I have exposed in *The Trigger* how Sabbatian technocrats, intelligence and military operatives were behind the horrors of 9/11 and not '19 Arab hijackers' who somehow manifested the ability to pilot big passenger airliners when instructors at puddle-jumping flying schools described some of them as a joke. The 9/11 attacks were made possible through control of civilian and military air computer systems and those of the White House, Pentagon and connected agencies. See *The Trigger* – it

will blow your mind. The controlling and coordinating force were the Sabbatian networks in Israel and the United States which by then had infiltrated the entire US government, military and intelligence system. The real name of the American Deep State is 'Sabbatian State'. Israel is a tiny country of only nine million people, but it is one of the global centres of cyber operations and fast catching Silicon Valley in importance to the Cult. Israel is known as the 'start-up nation' for all the cyber companies spawned there with the Sabbatian specialisation of 'cyber security' that I mentioned earlier which gives those companies access to computer systems of their clients in real time through 'backdoors' written into the coding when security software is downloaded. The Sabbatian centre of cyber operations outside Silicon Valley is the Israeli military Cyber Intelligence Unit, the biggest infrastructure project in Israel's history, headquartered in the desert-city of Beersheba and involving some 20,000 'cyber soldiers'. Here are located a literal army of Internet trolls scanning social media, forums and comment lists for anyone challenging the Cult agenda. The UK military has something similar with its 77th Brigade and associated operations. The Beersheba complex includes research and development centres for other Cult operations such as Intel, Microsoft, IBM, Google, Apple, Hewlett-Packard, Cisco Systems, Facebook and Motorola. Techcrunch.com ran an article about the Beersheba global Internet technology centre headlined 'Israel's desert city of Beersheba is turning into a cybertech oasis':

> The military's massive relocation of its prestigious technology units, the presence of multinational and local companies, a close proximity to Ben Gurion University and generous government subsidies are turning Beersheba into a major global cybertech hub. Beersheba has all of the ingredients of a vibrant security technology ecosystem, including Ben Gurion University with its graduate program in cybersecurity and Cyber Security Research Center, and the presence of companies such as EMC, Deutsche Telekom, PayPal, Oracle, IBM, and Lockheed Martin. It's also the future home of the INCB (Israeli National Cyber Bureau); offers a special income tax incentive for cyber security companies, and was the site for the relocation of the army's intelligence corps units.

Sabbatians have taken over the cyber world through the following process: They scan the schools for likely cyber talent and develop them at Ben Gurion University and their period of conscription in the Israeli Defense Forces when they are stationed at the Beersheba complex. When the cyber talented officially leave the army they are funded to start cyber companies with technology developed by themselves or given to them by the state. Much of this is stolen through backdoors of computer systems around the world with America top of the list. Others are sent off to Silicon Valley to start companies or join the major ones and so we have many major positions filled by apparently 'Jewish' but really Sabbatian operatives. Google, YouTube and Facebook are all run by 'Jewish' CEOs while Twitter is all but run by ultra-Zionist hedge-fund shark Paul Singer. At the centre of the Sabbatian global cyber web is the Israeli army's Unit 8200 which specialises in hacking into computer systems of other countries, inserting viruses, gathering information, instigating malfunction, and even taking control of them from a distance. A long list of Sabbatians involved with 9/11, Silicon Valley and Israeli cyber security companies are operatives of Unit 8200. This is not about Israel. It's about the Cult. Israel is planned to be a Smart Grid hub as with China and what is happening at Beersheba is not for the benefit of Jewish people who are treated disgustingly by the Sabbatian elite that control the country. A glance at the Nuremberg Codes will tell you that.

The story is much bigger than 'Covid', important as that is to where we are being taken. Now, though, it's time to really strap in. There's more … much more …

CHAPTER ELEVEN

Who controls the Cult?

Awake, arise or be forever fall'n
John Milton, *Paradise Lost*

I have exposed this far the level of the Cult conspiracy that operates in the world of the seen and within the global secret society and satanic network which operates in the shadows one step back from the seen. The story, however, goes much deeper than that.

The 'Covid' hoax is major part of the Cult agenda, but only part, and to grasp the biggest picture we have to expand our attention beyond the realm of human sight and into the infinity of possibility that we cannot see. It is from here, ultimately, that humanity is being manipulated into a state of total control by the force which dictates the actions of the Cult. How much of reality can we see? Next to damn all is the answer. We may appear to see all there is to see in the 'space' our eyes survey and observe, but little could be further from the truth. The human 'world' is only a tiny band of frequency that the body's visual and perceptual systems can decode into *perception* of a 'world'. According to mainstream science the electromagnetic spectrum is 0.005 percent of what exists in the Universe (Fig 10). The maximum estimate I have seen is 0.5 percent and either way it's miniscule. I say it is far, far, smaller even than 0.005 percent when you compare reality we see with the totality of reality that we don't. Now get this if you are new to such information: Visible light, the only band of frequency that we can see, is a *fraction* of the 0.005

percent (Fig 11 overleaf). Take this further and realise that our universe is one of infinite universes and that universes are only a fragment of overall reality – *infinite* reality. Then compare that with the almost infinitesimal frequency band of visible light or human sight. You see that humans are as near blind as it is possible to be without actually being so. Artist and filmmaker, Sergio Toporek, said:

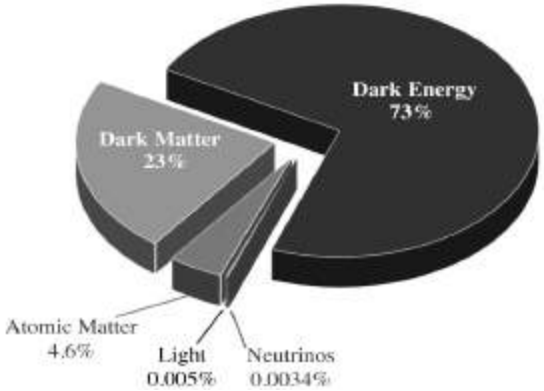

Figure 10: Humans can perceive such a tiny band of visual reality it's laughable.

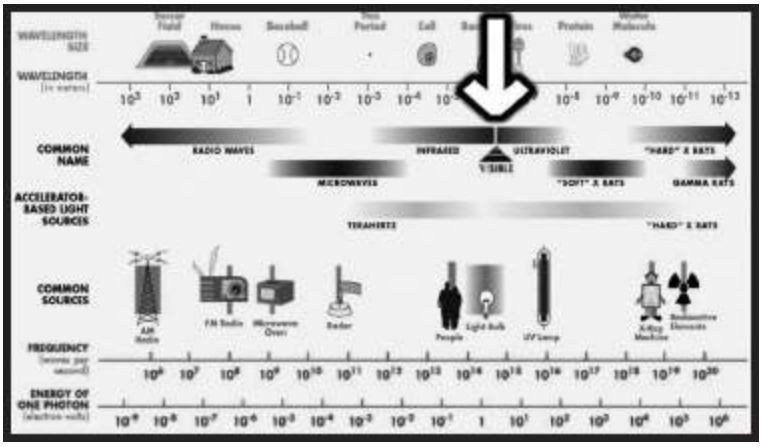

Figure 11: We can see a smear of the 0.005 percent electromagnetic spectrum, but we still know it all. Yep, makes sense.

Consider that you can see less than 1% of the electromagnetic spectrum and hear less than 1% of the acoustic spectrum. 90% of the cells in your body carry their own microbial DNA and are not 'you'. The atoms in your body are 99.9999999999999999% empty space and none of them are the ones you were born with ... Human beings have 46 chromosomes, two less than a potato.

The existence of the rainbow depends on the conical photoreceptors in your eyes; to animals without cones, the rainbow does not exist. So you don't just look at a rainbow, you create it. This is pretty amazing, especially considering that all the beautiful colours you see represent less than 1% of the electromagnetic spectrum.

Suddenly the 'world' of humans looks a very different place. Take into account, too, that Planet Earth when compared with the projected size of this single universe is the equivalent of a billionth of a pinhead. Imagine the ratio that would be when compared to infinite reality. To think that Christianity once insisted that Earth and humanity were the centre of everything. This background is vital if we are going to appreciate the nature of 'human' and how we can be manipulated by an unseen force. To human visual reality virtually *everything* is unseen and yet the prevailing perception within the institutions and so much of the public is that if we can't see it, touch it, hear it, taste it and smell it then it cannot exist. Such perception is indoctrinated and encouraged by the Cult and its agents because it isolates believers in the strictly limited, village-idiot, realm of the five senses where perceptions can be firewalled and information controlled. Most of those perpetuating the 'this-world-is-all-there-is' insanity are themselves indoctrinated into believing the same delusion. While major players and influencers know that official reality is laughable most of those in science, academia and medicine really believe the nonsense they peddle and teach succeeding generations. Those who challenge the orthodoxy are dismissed as nutters and freaks to protect the manufactured illusion from exposure. Observe the dynamic of the 'Covid' hoax and you will see how that takes the same form. The inner-circle psychopaths knows it's a gigantic scam, but almost the entirety of those imposing their fascist rules believe that 'Covid' is all that they're told it is.

Stolen identity

Ask people who they are and they will give you their name, place of birth, location, job, family background and life story. Yet that is not who they are – it is what they are *experiencing*. The difference is *absolutely crucial*. The true 'I', the eternal, infinite 'I', is consciousness,

a state of being aware. Forget 'form'. That is a vehicle for a brief experience. Consciousness does not come *from* the brain, but *through* the brain and even that is more symbolic than literal. We are awareness, pure awareness, and this is what withdraws from the body at what we call 'death' to continue our eternal beingness, *isness*, in other realms of reality within the limitlessness of infinity or the Biblical 'many mansions in my father's house'. Labels of a human life, man, woman, transgender, black, white, brown, nationality, circumstances and income are not who we are. They are what we are – awareness – is *experiencing* in a brief connection with a band of frequency we call 'human'. The labels are not the self; they are, to use the title of one of my books, a *Phantom* Self. I am not David Icke born in Leicester, England, on April 29th, 1952. I am the consciousness *having that experience*. The Cult and its non-human masters seek to convince us through the institutions of 'education', science, medicine, media and government that what we are *experiencing* is who we *are*. It's so easy to control and direct perception locked away in the bewildered illusions of the five senses with no expanded radar. Try, by contrast, doing the same with a humanity aware of its true self and its true power to consciously create its reality and experience. How is it possible to do this? We do it all day every day. If you perceive yourself as 'little me' with no power to impact upon your life and the world then your life experience will reflect that. You will hand the power you don't think you have to authority in all its forms which will use it to control your experience. This, in turn, will appear to confirm your perception of 'little me' in a self-fulfilling feedback loop. But that is what 'little me' really is – a *perception*. We are all 'big-me', infinite me, and the Cult has to make us forget that if its will is to prevail. We are therefore manipulated and pressured into self-identifying with human labels and not the consciousness/awareness *experiencing* those human labels.

The phenomenon of identity politics is a Cult-instigated manipulation technique to sub-divide previous labels into even smaller ones. A United States university employs this list of letters to

describe student identity: LGBTTQQFAGPBDSM or lesbian, gay, bisexual, transgender, transsexual, queer, questioning, flexual, asexual, gender-fuck, polyamorous, bondage/discipline, dominance/submission and sadism/masochism. I'm sure other lists are even longer by now as people feel the need to self-identity the 'I' with the minutiae of race and sexual preference. Wokers programmed by the Cult for generations believe this is about 'inclusivity' when it's really the Cult locking them away into smaller and smaller versions of Phantom Self while firewalling them from the influence of their true self, the infinite, eternal 'I'. You may notice that my philosophy which contends that we are all unique points of attention/awareness within the same infinite whole or Oneness is the ultimate non-racism. The very sense of Oneness makes the judgement of people by their body-type, colour or sexuality utterly ridiculous and confirms that racism has no understanding of reality (including anti-white racism). Yet despite my perception of life Cult agents and fast-asleep Wokers label me racist to discredit my information while they are themselves phenomenally racist and sexist. All they see is race and sexuality and they judge people as good or bad, demons or untouchables, by their race and sexuality. All they see is *Phantom Self* and perceive themselves in terms of Phantom Self. They are pawns and puppets of the Cult agenda to focus attention and self-identity in the five senses and play those identities against each other to divide and rule. Columbia University has introduced segregated graduations in another version of social distancing designed to drive people apart and teach them that different racial and cultural groups have nothing in common with each other. The last thing the Cult wants is unity. Again the pump-primers of this will be Cult operatives in the knowledge of what they are doing, but the rest are just the Phantom Self blind leading the Phantom Self blind. We *do* have something in common – we are all *the same consciousness* having different temporary experiences.

What is this 'human'?

Yes, what *is* 'human'? That is what we are supposed to be, right? I mean 'human'? True, but 'human' is the experience not the 'I'. Break it down to basics and 'human' is the way that information is processed. If we are to experience and interact with this band of frequency we call the 'world' we must have a vehicle that operates within that band of frequency. Our consciousness in its prime form cannot do that; it is way beyond the frequency of the human realm. My consciousness or awareness could not tap these keys and pick up the cup in front of me in the same way that radio station A cannot interact with radio station B when they are on different frequencies. The human body is the means through which we have that interaction. I have long described the body as a biological computer which processes information in a way that allows consciousness to experience this reality. The body is a receiver, transmitter and processor of information in a particular way that we call human. We visually perceive only the world of the five senses in a wakened state – that is the limit of the body's visual decoding system. In truth it's not even visual in the way we experience 'visual reality' as I will come to in a moment. We are 'human' because the body processes the information sources of human into a reality and behaviour system that we *perceive* as human. Why does an elephant act like an elephant and not like a human or a duck? The elephant's biological computer is a different information field and processes information according to that program into a visual and behaviour type we call an elephant. The same applies to everything in our reality. These body information fields are perpetuated through procreation (like making a copy of a software program). The Cult wants to break that cycle and intervene technologically to transform the human information field into one that will change what we call humanity. If it can change the human information field it will change the way that field processes information and change humanity both 'physically' and psychologically. Hence the *messenger* (information) RNA 'vaccines' and so much more that is targeting human genetics by changing the body's information – *messaging* – construct through food, drink, radiation, toxicity and other means.

Reality that we experience is nothing like reality as it really is in the same way that the reality people experience in virtual reality games is not the reality they are really living in. The game is only a decoded source of information that appears to be a reality. Our world is also an information construct – a *simulation* (more later). In its base form our reality is a wavefield of information much the same in theme as Wi-Fi. The five senses decode wavefield information into electrical information which they communicate to the brain to decode into holographic (illusory 'physical') information. Different parts of the brain specialise in decoding different senses and the information is fused into a reality that appears to be outside of us but is really inside the brain and the genetic structure in general (Fig 12 overleaf). DNA is a receiver-transmitter of information and a vital part of this decoding process and the body's connection to other realities. Change DNA and you change the way we decode and connect with reality – see 'Covid vaccines'. Think of computers decoding Wi-Fi. You have information encoded in a radiation field and the computer decodes that information into a very different form on the screen. You can't see the Wi-Fi until its information is made manifest on the screen and the information on the screen is inside the computer and not outside. I have just described how we decode the 'human world'. All five senses decode the waveform 'Wi-Fi' field into electrical signals and the brain (computer) constructs reality inside the brain and not outside – 'You don't just look at a rainbow, you create it'. Sound is a simple example. We don't hear sound until the brain decodes it. Waveform sound waves are picked up by the hearing sense and communicated to the brain in an electrical form to be decoded into the sounds that we hear. Everything we hear is inside the brain along with everything we see, feel, smell and taste. Words and language are waveform fields generated by our vocal chords which pass through this process until they are decoded by the brain into words that we hear. Different languages are different frequency fields or sound waves generated by vocal chords. Late British philosopher Alan Watts said:

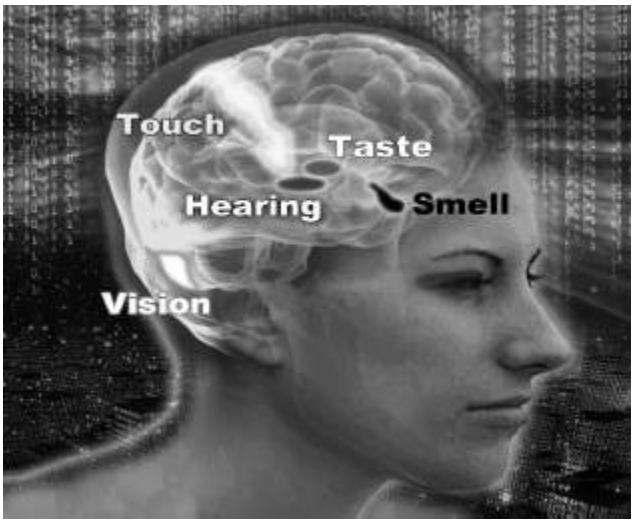

Figure 12: The brain receives information from the five senses and constructs from that our perceived reality.

[Without the brain] the world is devoid of light, heat, weight, solidity, motion, space, time or any other imaginable feature. All these phenomena are interactions, or transactions, of vibrations with a certain arrangement of neurons.

That's exactly what they are and scientist Robert Lanza describes in his book, *Biocentrism*, how we decode electromagnetic waves and energy into visual and 'physical' experience. He uses the example of a flame emitting photons, electromagnetic energy, each pulsing electrically and magnetically:

… these … invisible electromagnetic waves strike a human retina, and if (and only if) the waves happen to measure between 400 and 700 nano meters in length from crest to crest, then their energy is just right to deliver a stimulus to the 8 million cone-shaped cells in the retina.

Each in turn send an electrical pulse to a neighbour neuron, and on up the line this goes, at 250 mph, until it reaches the … occipital lobe of the brain, in the back of the head. There, a cascading complex of neurons fire from the incoming stimuli, and we subjectively perceive this experience as a yellow brightness occurring in a place we have been conditioned to call the 'external world'.

You hear what you decode

If a tree falls or a building collapses they make no noise unless someone is there to decode the energetic waves generated by the disturbance into what we call sound. Does a falling tree make a noise? Only if you hear it – *decode* it. Everything in our reality is a frequency field of information operating within the overall 'Wi-Fi' field that I call The Field. A vibrational disturbance is generated in The Field by the fields of the falling tree or building. These disturbance waves are what we decode into the sound of them falling. If no one is there to do that then neither will make any noise. Reality is created by the observer – *decoder* – and the *perceptions* of the observer affect the decoding process. For this reason different people – different *perceptions* – will perceive the same reality or situation in a different way. What one may perceive as a nightmare another will see as an opportunity. The question of why the Cult is so focused on controlling human perception now answers itself. All experienced reality is the act of decoding and we don't experience Wi-Fi until it is decoded on the computer screen. The sight and sound of an Internet video is encoded in the Wi-Fi all around us, but we don't see or hear it until the computer decodes that information. Taste, smell and touch are all phenomena of the brain as a result of the same process. We don't taste, smell or feel anything except in the brain and there are pain relief techniques that seek to block the signal from the site of discomfort to the brain because if the brain doesn't decode that signal we don't feel pain. Pain is in the brain and only appears to be at the point of impact thanks to the feedback loop between them. We don't see anything until electrical information from the sight senses is decoded in an area at the back of the brain. If that area is damaged we can go blind when our eyes are perfectly okay. So why do we go blind if we damage an eye? We damage the information processing between the waveform visual information and the visual decoding area of the brain. If information doesn't reach the brain in a form it can decode then we can't see the visual reality that it represents. What's more the brain is decoding only a fraction of the information it receives and the rest is absorbed by the

sub-conscious mind. This explanation is from the science magazine, *Wonderpedia*:

> Every second, 11 million sensations crackle along these [brain] pathways ... The brain is confronted with an alarming array of images, sounds and smells which it rigorously filters down until it is left with a manageable list of around 40. Thus 40 sensations per second make up what we perceive as reality.

The 'world' is not what people are told to believe that is it and the inner circles of the Cult *know that*.

Illusory 'physical' reality

We can only see a smear of 0.005 percent of the Universe which is only one of a vast array of universes – 'mansions' – within infinite reality. Even then the brain decodes only 40 pieces of information ('sensations') from a potential *11 million* that we receive every second. Two points strike you from this immediately: The sheer breathtaking stupidity of believing we know anything so rigidly that there's nothing more to know; and the potential for these processes to be manipulated by a malevolent force to control the reality of the population. One thing I can say for sure with no risk of contradiction is that when you can perceive an almost indescribable fraction of infinite reality there is always more to know as in tidal waves of it. Ancient Greek philosopher Socrates was so right when he said that wisdom is to know how little we know. How obviously true that is when you think that we are experiencing a physical world of solidity that is neither physical nor solid and a world of apartness when everything is connected. Cult-controlled 'science' dismisses the so-called 'paranormal' and all phenomena related to that when the 'para'-normal is perfectly normal and explains the alleged 'great mysteries' which dumbfound scientific minds. There is a reason for this. A 'scientific mind' in terms of the mainstream is a material mind, a five-sense mind imprisoned in see it, touch it, hear it, smell it and taste it. Phenomena and happenings that can't be explained that way leave the 'scientific mind' bewildered and the rule is that if they

can't account for why something is happening then it can't, by definition, be happening. I beg to differ. Telepathy is thought waves passing through The Field (think wave disturbance again) to be decoded by someone able to connect with that wavelength (information). For example: You can pick up the thought waves of a friend at any distance and at the very least that will bring them to mind. A few minutes later the friend calls you. 'My god', you say, 'that's incredible – I was just thinking of you.' Ah, but *they* were thinking of *you* before they made the call and that's what you decoded. Native peoples not entrapped in five-sense reality do this so well it became known as the 'bush telegraph'. Those known as psychics and mediums (genuine ones) are doing the same only across dimensions of reality. 'Mind over matter' comes from the fact that matter and mind are the *same*. The state of one influences the state of the other. Indeed one *and* the other are illusions. They are aspects of the same field. Paranormal phenomena are all explainable so why are they still considered 'mysteries' or not happening? Once you go down this road of understanding you begin to expand awareness beyond the five senses and that's the nightmare for the Cult.

Figure 13: Holograms are not solid, but the best ones appear to be.

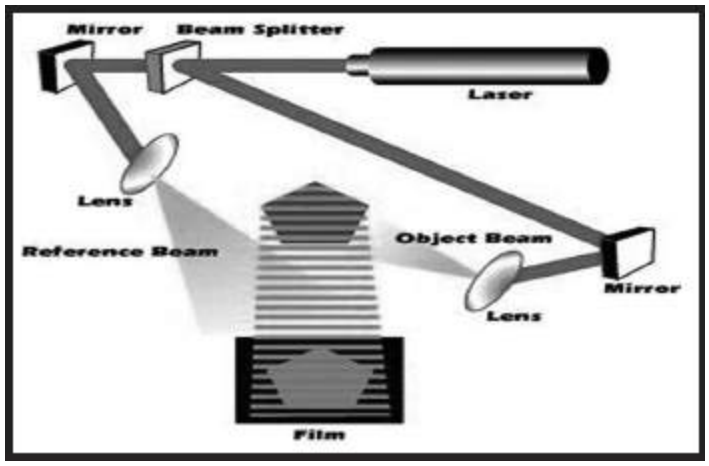

Figure 14: How holograms are created by capturing a waveform version of the subject image.

Holographic 'solidity'

Our reality is not solid, it is holographic. We are now well aware of holograms which are widely used today. Two-dimensional information is decoded into a three-dimensional reality that is not solid although can very much appear to be (Fig 13). Holograms are created with a laser divided into two parts. One goes directly onto a holographic photographic print ('reference beam') and the other takes a waveform image of the subject ('working beam') before being directed onto the print where it 'collides' with the other half of the laser (Fig 14). This creates a *waveform* interference pattern which contains the wavefield information of whatever is being photographed (Fig 15 overleaf). The process can be likened to dropping pebbles in a pond. Waves generated by each one spread out across the water to collide with the others and create a wave representation of where the stones fell and at what speed, weight and distance. A waveform interference pattern of a hologram is akin to the waveform information in The Field which the five senses decode into electrical signals to be decoded by the brain into a holographic illusory 'physical' reality. In the same way when a laser (think human attention) is directed at the waveform interference pattern a three-dimensional version of the subject is projected into apparently 'solid' reality (Fig 16). An amazing trait of holograms reveals more 'paranormal mysteries'. Information of the *whole*

hologram is encoded in waveform in every part of the interference pattern by the way they are created. This means that every *part* of a hologram is a smaller version of the whole. Cut the interference wave-pattern into four and you won't get four parts of the image. You get quarter-sized versions of the *whole* image. The body is a hologram and the same applies. Here we have the basis of acupuncture, reflexology and other forms of healing which identify representations of the whole body in all of the parts, hands, feet, ears, everywhere. Skilled palm readers can do what they do because the information of whole body is encoded in the hand. The concept of as above, so below, comes from this.

Figure 15: A waveform interference pattern that holds the information that transforms into a hologram.

Figure 16: Holographic people including 'Elvis' holographically inserted to sing a duet with Celine Dion.

The question will be asked of why, if solidity is illusory, we can't just walk through walls and each other. The resistance is not solid against solid; it is electromagnetic field against electromagnetic field and we decode this into the *experience* of solid against solid. We should also not underestimate the power of belief to dictate reality. What you believe is impossible *will be*. Your belief impacts on your decoding processes and they won't decode what you think is impossible. What we believe we perceive and what we perceive we experience. 'Can't dos' and 'impossibles' are like a firewall in a computer system that won't put on the screen what the firewall blocks. How vital that is to understanding how human experience has been hijacked. I explain in *The Answer*, *Everything You Need To Know But Have Never Been Told* and other books a long list of 'mysteries' and 'paranormal' phenomena that are not mysterious and perfectly normal once you realise what reality is and how it works. 'Ghosts' can be seen to pass through 'solid' walls because the walls are not solid and the ghost is a discarnate entity operating on a frequency so different to that of the wall that it's like two radio stations sharing the same space while never interfering with each other. I have seen ghosts do this myself. The apartness of people and objects is also an illusion. Everything is connected by the Field like all sea life is connected by the sea. It's just that within the limits of our visual reality we only 'see' holographic information and not the field of information that connects everything and from which the holographic world is made manifest. If you can only see holographic 'objects' and not the field that connects them they will appear to you as unconnected to each other in the same way that we see the computer while not seeing the Wi-Fi.

What you don't know *can* hurt you

Okay, we return to those 'two worlds' of human society and the Cult with its global network of interconnecting secret societies and satanic groups which manipulate through governments, corporations, media, religions, etc. The fundamental difference between them is *knowledge*. The idea has been to keep humanity

ignorant of the plan for its total enslavement underpinned by a crucial ignorance of reality – who we are and where we are – and how we interact with it. 'Human' should be the interaction between our expanded eternal consciousness and the five-sense body experience. We are meant to be *in* this world in terms of the five senses but not *of* this world in relation to our greater consciousness and perspective. In that state we experience the small picture of the five senses within the wider context of the big picture of awareness beyond the five senses. Put another way the five senses see the dots and expanded awareness connects them into pictures and patterns that give context to the apparently random and unconnected. Without the context of expanded awareness the five senses see only apartness and randomness with apparently no meaning. The Cult and its other-dimensional controllers seek to intervene in the frequency realm where five-sense reality is supposed to connect with expanded reality and to keep the two apart (more on this in the final chapter). When that happens five-sense mental and emotional processes are no longer influenced by expanded awareness, or the True 'I', and instead are driven by the isolated perceptions of the body's decoding systems. They are in the world *and* of it. Here we have the human plight and why humanity with its potential for infinite awareness can be so easily manipulatable and descend into such extremes of stupidity.

Once the Cult isolates five-sense mind from expanded awareness it can then program the mind with perceptions and beliefs by controlling information that the mind receives through the 'education' system of the formative years and the media perceptual bombardment and censorship of an entire lifetime. Limit perception and a sense of the possible through limiting knowledge by limiting and skewing information while censoring and discrediting that which could set people free. As the title of another of my books says *… And The Truth Shall Set You Free*. For this reason the last thing the Cult wants in circulation is the truth about anything – especially the reality of the eternal 'I' – and that's why it is desperate to control information. The Cult knows that information becomes perception

which becomes behaviour which, collectively, becomes human society. Cult-controlled and funded mainstream 'science' denies the existence of an eternal 'I' and seeks to dismiss and trash all evidence to the contrary. Cult-controlled mainstream religion has a version of 'God' that is little more than a system of control and dictatorship that employs threats of damnation in an afterlife to control perceptions and behaviour in the here and now through fear and guilt. Neither is true and it's the 'neither' that the Cult wishes to suppress. This 'neither' is that everything is an expression, a point of attention, within an infinite state of consciousness which is the real meaning of the term 'God'.

Perceptual obsession with the 'physical body' and five-senses means that 'God' becomes personified as a bearded bloke sitting among the clouds or a raging bully who loves us if we do what 'he' wants and condemns us to the fires of hell if we don't. These are no more than a 'spiritual' fairy tales to control and dictate events and behaviour through fear of this 'God' which has bizarrely made 'God-fearing' in religious circles a state to be desired. I would suggest that fearing *anything* is not to be encouraged and celebrated, but rather deleted. You can see why 'God fearing' is so beneficial to the Cult and its religions when *they* decide what 'God' wants and what 'God' demands (the Cult demands) that everyone do. As the great American comedian Bill Hicks said satirising a Christian zealot: 'I think what God meant to say.' How much of this infinite awareness ('God') that we access is decided by how far we choose to expand our perceptions, self-identity and sense of the possible. The scale of self-identity reflects itself in the scale of awareness that we can connect with and are influenced by – how much knowing and insight we have instead of programmed perception. You cannot expand your awareness into the infinity of possibility when you believe that you are little me Peter the postman or Mary in marketing and nothing more. I'll deal with this in the concluding chapter because it's crucial to how we turnaround current events.

Where the Cult came from

When I realised in the early 1990s there was a Cult network behind global events I asked the obvious question: When did it start? I took it back to ancient Rome and Egypt and on to Babylon and Sumer in Mesopotamia, the 'Land Between Two Rivers', in what we now call Iraq. The two rivers are the Tigris and Euphrates and this region is of immense historical and other importance to the Cult, as is the land called Israel only 550 miles away by air. There is much more going with deep esoteric meaning across this whole region. It's not only about 'wars for oil'. Priceless artefacts from Mesopotamia were stolen or destroyed after the American and British invasion of Iraq in 2003 justified by the lies of Boy Bush and Tony Blair (their Cult masters) about non-existent 'weapons of mass destruction'. Mesopotamia was the location of Sumer (about 5,400BC to 1,750BC), and Babylon (about 2,350BC to 539BC). Sabbatians may have become immensely influential in the Cult in modern times but they are part of a network that goes back into the mists of history. Sumer is said by historians to be the 'cradle of civilisation'. I disagree. I say it was the re-start of what we call human civilisation after cataclysmic events symbolised in part as the 'Great Flood' destroyed the world that existed before. These fantastic upheavals that I have been describing in detail in the books since the early1990s appear in accounts and legends of ancient cultures across the world and they are supported by geological and biological evidence. Stone tablets found in Iraq detailing the Sumer period say the cataclysms were caused by non-human 'gods' they call the Anunnaki. These are described in terms of extraterrestrial visitations in which knowledge supplied by the Anunnaki is said to have been the source of at least one of the world's oldest writing systems and developments in astronomy, mathematics and architecture that were way ahead of their time. I have covered this subject at length in *The Biggest Secret* and *Children of the Matrix* and the same basic 'Anunnaki' story can be found in Zulu accounts in South Africa where the late and very great Zulu high shaman Credo Mutwa told me that the Sumerian Anunnaki were known by Zulus as the Chitauri or 'children of the serpent'. See my six-hour video interview with Credo on this subject entitled *The*

Reptilian Agenda recorded at his then home near Johannesburg in 1999 which you can watch on the Ickonic media platform.

The Cult emerged out of Sumer, Babylon and Egypt (and elsewhere) and established the Roman Empire before expanding with the Romans into northern Europe from where many empires were savagely imposed in the form of Cult-controlled societies all over the world. Mass death and destruction was their calling card. The Cult established its centre of operations in Europe and European Empires were Cult empires which allowed it to expand into a global force. Spanish and Portuguese colonialists headed for Central and South America while the British and French targeted North America. Africa was colonised by Britain, France, Belgium, the Netherlands, Portugal, Spain, Italy, and Germany. Some like Britain and France moved in on the Middle East. The British Empire was by far the biggest for a simple reason. By now Britain was the headquarters of the Cult from which it expanded to form Canada, the United States, Australia and New Zealand. The Sun never set on the British Empire such was the scale of its occupation. London remains a global centre for the Cult along with Rome and the Vatican although others have emerged in Israel and China. It is no accident that the 'virus' is alleged to have come out of China while Italy was chosen as the means to terrify the Western population into compliance with 'Covid' fascism. Nor that Israel has led the world in 'Covid' fascism and mass 'vaccination'.

You would think that I would mention the United States here, but while it has been an important means of imposing the Cult's will it is less significant than would appear and is currently in the process of having what power it does have deleted. The Cult in Europe has mostly loaded the guns for the US to fire. America has been controlled from Europe from the start through Cult operatives in Britain and Europe. The American Revolution was an illusion to make it appear that America was governing itself while very different forces were pulling the strings in the form of Cult families such as the Rothschilds through the Rockefellers and other subordinates. The Rockefellers are extremely close to Bill Gates and

established both scalpel and drug 'medicine' and the World Health Organization. They play a major role in the development and circulation of vaccines through the Rockefeller Foundation on which Bill Gates said his Foundation is based. Why wouldn't this be the case when the Rockefellers and Gates are on the same team? Cult infiltration of human society goes way back into what we call history and has been constantly expanding and centralising power with the goal of establishing a global structure to dictate everything. Look how this has been advanced in great leaps with the 'Covid' hoax.

The non-human dimension

I researched and observed the comings and goings of Cult operatives through the centuries and even thousands of years as they were born, worked to promote the agenda within the secret society and satanic networks, and then died for others to replace them. Clearly there had to be a coordinating force that spanned this entire period while operatives who would not have seen the end goal in their lifetimes came and went advancing the plan over millennia. I went in search of that coordinating force with the usual support from the extraordinary synchronicity of my life which has been an almost daily experience since 1990. I saw common themes in religious texts and ancient cultures about a non-human force manipulating human society from the hidden. Christianity calls this force Satan, the Devil and demons; Islam refers to the Jinn or Djinn; Zulus have their Chitauri (spelt in other ways in different parts of Africa); and the Gnostic people in Egypt in the period around and before 400AD referred to this phenomena as the 'Archons', a word meaning rulers in Greek. Central American cultures speak of the 'Predators' among other names and the same theme is everywhere. I will use 'Archons' as a collective name for all of them. When you see how their nature and behaviour is described all these different sources are clearly talking about the same force. Gnostics described the Archons in terms of 'luminous fire' while Islam relates the Jinn to 'smokeless fire'. Some refer to beings in form that could occasionally be seen, but the most common of common theme is that they operate from

unseen realms which means almost all existence to the visual processes of humans. I had concluded that this was indeed the foundation of human control and that the Cult was operating within the human frequency band on behalf of this hidden force when I came across the writings of Gnostics which supported my conclusions in the most extraordinary way.

A sealed earthen jar was found in 1945 near the town of Nag Hammadi about 75-80 miles north of Luxor on the banks of the River Nile in Egypt. Inside was a treasure trove of manuscripts and texts left by the Gnostic people some 1,600 years earlier. They included 13 leather-bound papyrus codices (manuscripts) and more than 50 texts written in Coptic Egyptian estimated to have been hidden in the jar in the period of 400AD although the source of the information goes back much further. Gnostics oversaw the Great or Royal Library of Alexandria, the fantastic depository of ancient texts detailing advanced knowledge and accounts of human history. The Library was dismantled and destroyed in stages over a long period with the death-blow delivered by the Cult-established Roman Church in the period around 415AD. The Church of Rome was the Church of Babylon relocated as I said earlier. Gnostics were not a race. They were a way of perceiving reality. Whenever they established themselves and their information circulated the terrorists of the Church of Rome would target them for destruction. This happened with the Great Library and with the Gnostic Cathars who were burned to death by the psychopaths after a long period of oppression at the siege of the Castle of Monségur in southern France in 1244. The Church has always been terrified of Gnostic information which demolishes the official Christian narrative although there is much in the Bible that supports the Gnostic view if you read it in another way. To anyone studying the texts of what became known as the Nag Hammadi Library it is clear that great swathes of Christian and Biblical belief has its origin with Gnostics sources going back to Sumer. Gnostic themes have been twisted to manipulate the perceived reality of Bible believers. Biblical texts have been in the open for centuries where they could be changed while Gnostic

documents found at Nag Hammadi were sealed away and untouched for 1,600 years. What you see is what they wrote.

Use your *pneuma* not your *nous*

Gnosticism and Gnostic come from 'gnosis' which means knowledge, or rather *secret* knowledge, in the sense of spiritual awareness – knowledge about reality and life itself. The desperation of the Cult's Church of Rome to destroy the Gnostics can be understood when the knowledge they were circulating was the last thing the Cult wanted the population to know. Sixteen hundred years later the same Cult is working hard to undermine and silence me for the same reason. The dynamic between knowledge and ignorance is a constant. 'Time' appears to move on, but essential themes remain the same. We are told to 'use your nous', a Gnostic word for head/brain/intelligence. They said, however, that spiritual awakening or 'salvation' could only be secured by expanding awareness *beyond* what they called *nous* and into *pneuma* or Infinite Self. Obviously as I read these texts the parallels with what I have been saying since 1990 were fascinating to me. There is a universal truth that spans human history and in that case why wouldn't we be talking the same language 16 centuries apart? When you free yourself from the perception program of the five senses and explore expanded realms of consciousness you are going to connect with the same information no matter what the perceived 'era' within a manufactured timeline of a single and tiny range of manipulated frequency. Humans working with 'smart' technology or knocking rocks together in caves is only a timeline appearing to operate within the human frequency band. Expanded awareness and the knowledge it holds have always been there whether the era be Stone Age or computer age. We can only access that knowledge by opening ourselves to its frequency which the five-sense prison cell is designed to stop us doing. Gates, Fauci, Whitty, Vallance, Zuckerberg, Brin, Page, Wojcicki, Bezos, and all the others behind the 'Covid' hoax clearly have a long wait before their range of frequency can make that connection given that an open heart is

crucial to that as we shall see. Instead of accessing knowledge directly through expanded awareness it is given to Cult operatives by the secret society networks of the Cult where it has been passed on over thousands of years outside the public arena. Expanded realms of consciousness is where great artists, composers and writers find their inspiration and where truth awaits anyone open enough to connect with it. We need to go there fast.

Archon hijack

A fifth of the Nag Hammadi texts describe the existence and manipulation of the Archons led by a 'Chief Archon' they call 'Yaldabaoth', or the 'Demiurge', and this is the Christian 'Devil', 'Satan', 'Lucifer', and his demons. Archons in Biblical symbolism are the 'fallen ones' which are also referred to as fallen angels after the angels expelled from heaven according to the Abrahamic religions of Judaism, Christianity and Islam. These angels are claimed to tempt humans to 'sin' ongoing and you will see how accurate that symbolism is during the rest of the book. The theme of 'original sin' is related to the 'Fall' when Adam and Eve were 'tempted by the serpent' and fell from a state of innocence and 'obedience' (connection) with God into a state of disobedience (disconnection). The Fall is said to have brought sin into the world and corrupted everything including human nature. Yaldabaoth, the 'Lord Archon', is described by Gnostics as a 'counterfeit spirit', 'The Blind One', 'The Blind God', and 'The Foolish One'. The Jewish name for Yaldabaoth in Talmudic writings is Samael which translates as 'Poison of God', or 'Blindness of God'. You see the parallels. Yaldabaoth in Islamic belief is the Muslim Jinn devil known as Shaytan – Shaytan is Satan as the same themes are found all over the world in every religion and culture. The 'Lord God' of the Old Testament is the 'Lord Archon' of Gnostic manuscripts and that's why he's such a bloodthirsty bastard. Satan is known by Christians as 'the Demon of Demons' and Gnostics called Yaldabaoth the 'Archon of Archons'. Both are known as 'The Deceiver'. We are talking about the same 'bloke' for sure and these common themes

using different names, storylines and symbolism tell a common tale of the human plight.

Archons are referred to in Nag Hammadi documents as mind parasites, inverters, guards, gatekeepers, detainers, judges, pitiless ones and deceivers. The 'Covid' hoax alone is a glaring example of all these things. The Biblical 'God' is so different in the Old and New Testaments because they are not describing the same phenomenon. The vindictive, angry, hate-filled, 'God' of the Old Testament, known as Yahweh, is Yaldabaoth who is depicted in Cult-dictated popular culture as the 'Dark Lord', 'Lord of Time', Lord (Darth) Vader and Dormammu, the evil ruler of the 'Dark Dimension' trying to take over the 'Earth Dimension' in the Marvel comic movie, *Dr Strange*. Yaldabaoth is both the Old Testament 'god' and the Biblical 'Satan'. Gnostics referred to Yaldabaoth as the 'Great Architect of the Universe'and the Cult-controlled Freemason network calls their god 'the 'Great Architect of the Universe' (also Grand Architect). The 'Great Architect' Yaldabaoth is symbolised by the Cult as the all-seeing eye at the top of the pyramid on the Great Seal of the United States and the dollar bill. Archon is encoded in *arch*-itect as it is in *arch*-angels and *arch*-bishops. All religions have the theme of a force for good and force for evil in some sort of spiritual war and there is a reason for that – the theme is true. The Cult and its non-human masters are quite happy for this to circulate. They present themselves as the force for good fighting evil when they are really the force of evil (absence of love). The whole foundation of Cult modus operandi is inversion. They promote themselves as a force for good and anyone challenging them in pursuit of peace, love, fairness, truth and justice is condemned as a satanic force for evil. This has been the game plan throughout history whether the Church of Rome inquisitions of non-believers or 'conspiracy theorists' and 'anti-vaxxers' of today. The technique is the same whatever the timeline era.

Yaldabaoth is revolting (true)

Yaldabaoth and the Archons are said to have revolted against God with Yaldabaoth claiming to *be* God – the *All That Is*. The Old Testament 'God' (Yaldabaoth) demanded to be worshipped as such: ' *I am* the LORD, and there is none else, there is no God beside me' (Isaiah 45:5). I have quoted in other books a man who said he was the unofficial son of the late Baron Philippe de Rothschild of the Mouton-Rothschild wine producing estates in France who died in 1988 and he told me about the Rothschild 'revolt from God'. The man said he was given the name Phillip Eugene de Rothschild and we shared long correspondence many years ago while he was living under another identity. He said that he was conceived through 'occult incest' which (within the Cult) was 'normal and to be admired'. 'Phillip' told me about his experience attending satanic rituals with rich and famous people whom he names and you can see them and the wider background to Cult Satanism in my other books starting with *The Biggest Secret*. Cult rituals are interactions with Archontic 'gods'. 'Phillip' described Baron Philippe de Rothschild as 'a master Satanist and hater of God' and he used the same term 'revolt from God' associated with Yaldabaoth/Satan/Lucifer/the Devil in describing the Sabbatian Rothschild dynasty. 'I played a key role in my family's revolt from God', he said. That role was to infiltrate in classic Sabbatian style the Christian Church, but eventually he escaped the mind-prison to live another life. The Cult has been targeting religion in a plan to make worship of the Archons the global one-world religion. Infiltration of Satanism into modern 'culture', especially among the young, through music videos, stage shows and other means, is all part of this.

Nag Hammadi texts describe Yaldabaoth and the Archons in their prime form as energy – consciousness – and say they can take form if they choose in the same way that consciousness takes form as a human. Yaldabaoth is called 'formless' and represents a deeply inverted, distorted and chaotic state of consciousness which seeks to attached to humans and turn them into a likeness of itself in an attempt at assimilation. For that to happen it has to manipulate

humans into low frequency mental and emotional states that match its own. Archons can certainly appear in human form and this is the origin of the psychopathic personality. The energetic distortion Gnostics called Yaldabaoth *is* psychopathy. When psychopathic Archons take human form that human will be a psychopath as an expression of Yaldabaoth consciousness. Cult psychopaths are Archons in human form. The principle is the same as that portrayed in the 2009 *Avatar* movie when the American military travelled to a fictional Earth-like moon called Pandora in the Alpha Centauri star system to infiltrate a society of blue people, or Na'vi, by hiding within bodies that looked like the Na'vi. Archons posing as humans have a particular hybrid information field, part human, part Archon, (the ancient 'demigods') which processes information in a way that manifests behaviour to match their psychopathic evil, lack of empathy and compassion, and stops them being influenced by the empathy, compassion and love that a fully-human information field is capable of expressing. Cult bloodlines interbreed, be they royalty or dark suits, for this reason and you have their obsession with incest. Interbreeding with full-blown humans would dilute the Archontic energy field that guarantees psychopathy in its representatives in the human realm.

Gnostic writings say the main non-human forms that Archons take are *serpentine* (what I have called for decades 'reptilian' amid unbounded ridicule from the Archontically-programmed) and what Gnostics describe as 'an unborn baby or foetus with grey skin and dark, unmoving eyes'. This is an excellent representation of the ET 'Greys' of UFO folklore which large numbers of people claim to have seen and been abducted by – Zulu shaman Credo Mutwa among them. I agree with those that believe in extraterrestrial or interdimensional visitations today and for thousands of years past. No wonder with their advanced knowledge and technological capability they were perceived and worshipped as gods for technological and other 'miracles' they appeared to perform. Imagine someone arriving in a culture disconnected from the modern world with a smartphone and computer. They would be

seen as a 'god' capable of 'miracles'. The Renegade Mind, however, wants to know the source of everything and not only the way that source manifests as human or non-human. In the same way that a Renegade Mind seeks the original source material for the 'Covid virus' to see if what is claimed is true. The original source of Archons in form is consciousness – the distorted state of consciousness known to Gnostics as Yaldabaoth.

'Revolt from God' is energetic disconnection

Where I am going next will make a lot of sense of religious texts and ancient legends relating to 'Satan', Lucifer' and the 'gods'. Gnostic descriptions sync perfectly with the themes of my own research over the years in how they describe a consciousness distortion seeking to impose itself on human consciousness. I've referred to the core of infinite awareness in previous books as Infinite Awareness in Awareness of Itself. By that I mean a level of awareness that knows that it is all awareness and is aware of all awareness. From here comes the frequency of love in its true sense and balance which is what love is on one level – the balance of all forces into a single whole called Oneness and Isness. The more we disconnect from this state of love that many call 'God' the constituent parts of that Oneness start to unravel and express themselves as a part and not a whole. They become individualised as intellect, mind, selfishness, hatred, envy, desire for power over others, and such like. This is not a problem in the greater scheme in that 'God', the *All That Is*, can experience all these possibilities through different expressions of itself including humans. What we as expressions of the whole experience the *All That Is* experiences. We are the *All That Is* experiencing itself. As we withdraw from that state of Oneness we disconnect from its influence and things can get very unpleasant and very stupid. Archontic consciousness is at the extreme end of that. It has so disconnected from the influence of Oneness that it has become an inversion of unity and love, an inversion of everything, an inversion of life itself. Evil is appropriately live written backwards. Archontic consciousness is obsessed with death, an inversion of life,

and so its manifestations in Satanism are obsessed with death. They use inverted symbols in their rituals such as the inverted pentagram and cross. Sabbatians as Archontic consciousness incarnate invert Judaism and every other religion and culture they infiltrate. They seek disunity and chaos and they fear unity and harmony as they fear love like garlic to a vampire. As a result the Cult, Archons incarnate, act with such evil, psychopathy and lack of empathy and compassion disconnected as they are from the source of love. How could Bill Gates and the rest of the Archontic psychopaths do what they have to human society in the 'Covid' era with all the death, suffering and destruction involved and have no emotional consequence for the impact on others? Now you know. Why have Zuckerberg, Brin, Page, Wojcicki and company callously censored information warning about the dangers of the 'vaccine' while thousands have been dying and having severe, sometimes life-changing reactions? Now you know. Why have Tedros, Fauci, Whitty, Vallance and their like around the world been using case and death figures they're aware are fraudulent to justify lockdowns and all the deaths and destroyed lives that have come from that? Now you know. Why did Christian Drosten produce and promote a 'testing' protocol that he knew couldn't test for infectious disease which led to a global human catastrophe. Now you know. The Archontic mind doesn't give a shit (Fig 17). I personally think that Gates and major Cult insiders are a form of AI cyborg that the Archons want humans to become.

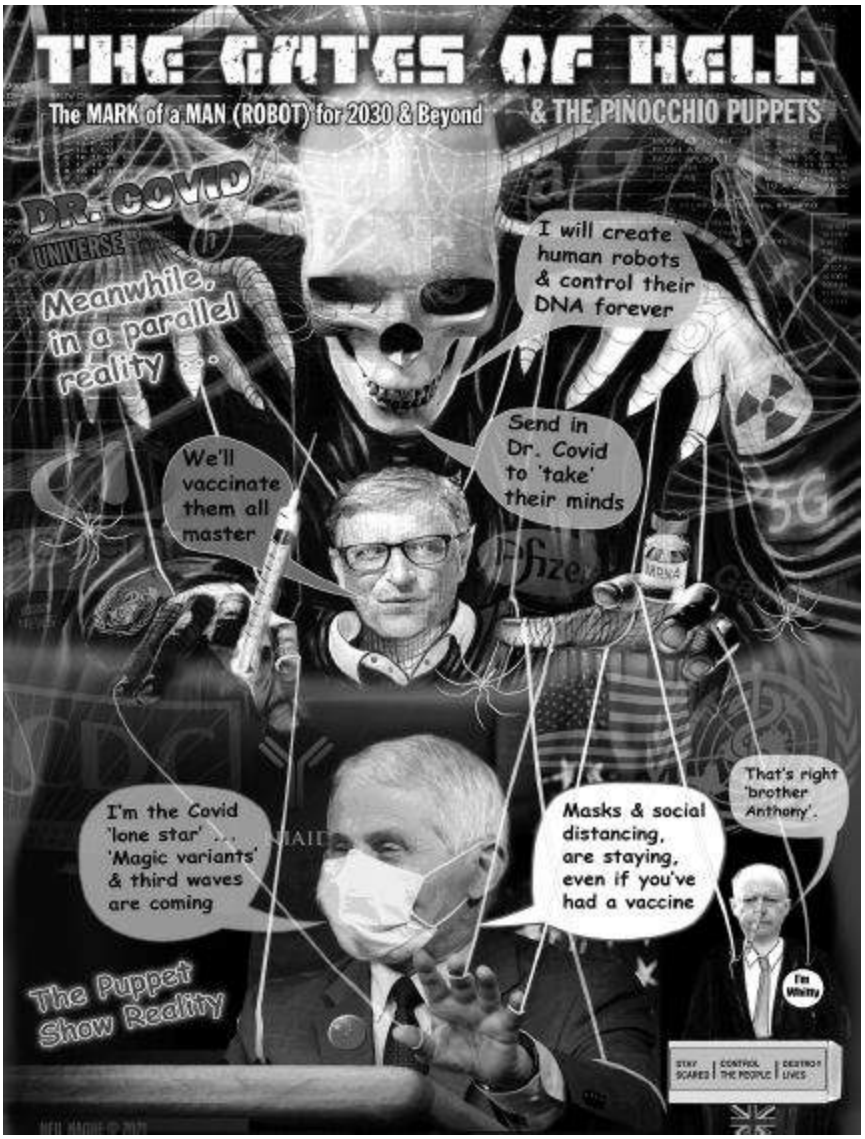
THE GATES OF HELL
The MARK of a MAN (ROBOT) for 2030 & Beyond
& THE PINOCCHIO PUPPETS
DR. COVID
UNIVERSE
Meanwhile, in a parallel reality ...
I will create human robots & control their DNA forever
Send in Dr. Covid to 'take' their minds
We'll vaccinate them all master
5G
I'm the Covid 'lone star' ... 'Magic variants' & third waves are coming
Masks & social distancing, are staying, even if you've had a vaccine
That's right 'brother Anthony'.
The Puppet Show Reality
I'm Whitty
STAY SCARED
CONTROL THE PEOPLE
DESTROY LIVES

Figure 17: Artist Neil Hague's version of the 'Covid' hierarchy.

Human batteries

A state of such inversion does have its consequences, however. The level of disconnection from the Source of All means that you withdraw from that source of energetic sustenance and creativity. This means that you have to find your own supply of energetic power and it has – *us*. When the Morpheus character in the first *Matrix* movie held up a battery he spoke a profound truth when he said: 'The Matrix is a computer-generated dream world built to keep us under control in order to change the human being into one of

these.' The statement was true in all respects. We do live in a technologically-generated virtual reality simulation (more very shortly) and we have been manipulated to be an energy source for Archontic consciousness. The Disney-Pixar animated movie *Monsters, Inc*. in 2001 symbolised the dynamic when monsters in their world had no energy source and they would enter the human world to terrify children in their beds, catch the child's scream, terror (low-vibrational frequencies), and take that energy back to power the monster world. The lead character you might remember was a single giant eye and the symbolism of the Cult's all-seeing eye was obvious. Every thought and emotion is broadcast as a frequency unique to that thought and emotion. Feelings of love and joy, empathy and compassion, are high, quick, frequencies while fear, depression, anxiety, suffering and hate are low, slow, dense frequencies. Which kind do you think Archontic consciousness can connect with and absorb? In such a low and dense frequency state there's no way it can connect with the energy of love and joy. Archons can only feed off energy compatible with their own frequency and they and their Cult agents want to delete the human world of love and joy and manipulate the transmission of low vibrational frequencies through low-vibrational human mental and emotional states. *We are their energy source*. Wars are energetic banquets to the Archons – a world war even more so – and think how much low-frequency mental and emotional energy has been generated from the consequences for humanity of the 'Covid' hoax orchestrated by Archons incarnate like Gates.

The ancient practice of human sacrifice 'to the gods', continued in secret today by the Cult, is based on the same principle. 'The gods' are Archontic consciousness in different forms and the sacrifice is induced into a state of intense terror to generate the energy the Archontic frequency can absorb. Incarnate Archons in the ritual drink the blood which contains an adrenaline they crave which floods into the bloodstream when people are terrorised. Most of the sacrifices, ancient and modern, are children and the theme of 'sacrificing young virgins to the gods' is just code for children. They

have a particular pre-puberty energy that Archons want more than anything and the energy of the young in general is their target. The California Department of Education wants students to chant the names of Aztec gods (Archontic gods) once worshipped in human sacrifice rituals in a curriculum designed to encourage them to 'challenge racist, bigoted, discriminatory, imperialist/colonial beliefs', join 'social movements that struggle for social justice', and 'build new possibilities for a post-racist, post-systemic racism society'. It's the usual Woke crap that inverts racism and calls it anti-racism. In this case solidarity with 'indigenous tribes' is being used as an excuse to chant the names of 'gods' to which people were sacrificed (and still are in secret). What an example of Woke's inability to see beyond black and white, us and them, They condemn the colonisation of these tribal cultures by Europeans (quite right), but those cultures sacrificing people including children to their 'gods', and mass murdering untold numbers as the Aztecs did, is just fine. One chant is to the Aztec god Tezcatlipoca who had a man sacrificed to him in the 5th month of the Aztec calendar. His heart was cut out and he was eaten. Oh, that's okay then. Come on children … after three … Other sacrificial 'gods' for the young to chant their allegiance include Quetzalcoatl, Huitzilopochtli and Xipe Totec. The curriculum says that 'chants, affirmations, and energizers can be used to bring the class together, build unity around ethnic studies principles and values, and to reinvigorate the class following a lesson that may be emotionally taxing or even when student engagement may appear to be low'. Well, that's the cover story, anyway. Chanting and mantras are the repetition of a particular frequency generated from the vocal cords and chanting the names of these Archontic 'gods' tunes you into their frequency. That is the last thing you want when it allows for energetic synchronisation, attachment and perceptual influence. Initiates chant the names of their 'Gods' in their rituals for this very reason.

Vampires of the Woke

Paedophilia is another way that Archons absorb the energy of children. Paedophiles possessed by Archontic consciousness are used as the conduit during sexual abuse for discarnate Archons to vampire the energy of the young they desire so much. Stupendous numbers of children disappear every year never to be seen again although you would never know from the media. Imagine how much low-vibrational energy has been generated by children during the 'Covid' hoax when so many have become depressed and psychologically destroyed to the point of killing themselves. Shocking numbers of children are now taken by the state from loving parents to be handed to others. I can tell you from long experience of researching this since 1996 that many end up with paedophiles and assets of the Cult through corrupt and Cult-owned social services which in the reframing era has hired many psychopaths and emotionless automatons to do the job. Children are even stolen to order using spurious reasons to take them by the corrupt and secret (because they're corrupt) 'family courts'. I have written in detail in other books, starting with *The Biggest Secret* in 1997, about the ubiquitous connections between the political, corporate, government, intelligence and military elites (Cult operatives) and Satanism and paedophilia. If you go deep enough both networks have an interlocking leadership. The Woke mentality has been developed by the Cult for many reasons: To promote almost every aspect of its agenda; to hijack the traditional political left and turn it fascist; to divide and rule; and to target agenda pushbackers. But there are other reasons which relate to what I am describing here. How many happy and joyful Wokers do you ever see especially at the extreme end? They are a mental and psychological mess consumed by emotional stress and constantly emotionally cocked for the next explosion of indignation at someone referring to a female as a female. They are walking, talking, batteries as Morpheus might say emitting frequencies which both enslave them in low-vibrational bubbles of perceptual limitation and feed the Archons. Add to this the hatred claimed to be love; fascism claimed to 'anti-fascism', racism claimed to be 'anti-racism';

exclusion claimed to inclusion; and the abuse-filled Internet trolling. You have a purpose-built Archontic energy system with not a wind turbine in sight and all founded on Archontic *inversion*. We have whole generations now manipulated to serve the Archons with their actions and energy. They will be doing so their entire adult lives unless they snap out of their Archon-induced trance. Is it really a surprise that Cult billionaires and corporations put so much money their way? Where is the energy of joy and laughter, including laughing at yourself which is confirmation of your own emotional security? Mark Twain said: 'The human race has one really effective weapon, and that is laughter.' We must use it all the time. Woke has destroyed comedy because it has no humour, no joy, sense of irony, or self-deprecation. Its energy is dense and intense. *Mmmmm*, lunch says the Archontic frequency. Rudolf Steiner (1861-1925) was the Austrian philosopher and famous esoteric thinker who established Waldorf education or Steiner schools to treat children like unique expressions of consciousness and not minds to be programmed with the perceptions determined by authority. I'd been writing about this energy vampiring for decades when I was sent in 2016 a quote by Steiner. He was spot on:

> There are beings in the spiritual realms for whom anxiety and fear emanating from human beings offer welcome food. When humans have no anxiety and fear, then these creatures starve. If fear and anxiety radiates from people and they break out in panic, then these creatures find welcome nutrition and they become more and more powerful. These beings are hostile towards humanity. Everything that feeds on negative feelings, on anxiety, fear and superstition, despair or doubt, are in reality hostile forces in super-sensible worlds, launching cruel attacks on human beings, while they are being fed ... These are exactly the feelings that belong to contemporary culture and materialism; because it estranges people from the spiritual world, it is especially suited to evoke hopelessness and fear of the unknown in people, thereby calling up the above mentioned hostile forces against them.

Pause for a moment from this perspective and reflect on what has happened in the world since the start of 2020. Not only will pennies drop, but billion dollar bills. We see the same theme from Don Juan Matus, a Yaqui Indian shaman in Mexico and the information source for Peruvian-born writer, Carlos Castaneda, who wrote a series of

books from the 1960s to 1990s. Don Juan described the force manipulating human society and his name for the Archons was the predator:

> We have a predator that came from the depths of the cosmos and took over the rule of our lives. Human beings are its prisoners. The predator is our lord and master. It has rendered us docile, helpless. If we want to protest, it suppresses our protest. If we want to act independently, it demands that we don't do so ... indeed we are held prisoner!
>
> They took us over because we are food to them, and they squeeze us mercilessly because we are their sustenance. Just as we rear chickens in coops, the predators rear us in human coops, humaneros. Therefore, their food is always available to them.
>
> Different cultures, different eras, same recurring theme.

The 'ennoia' dilemma

Nag Hammadi Gnostic manuscripts say that Archon consciousness has no 'ennoia'. This is directly translated as 'intentionality', but I'll use the term 'creative imagination'. The *All That Is* in awareness of itself is the source of all creativity – all possibility – and the more disconnected you are from that source the more you are subsequently denied 'creative imagination'. Given that Archon consciousness is almost entirely disconnected it severely lacks creativity and has to rely on far more mechanical processes of thought and exploit the creative potential of those that do have 'ennoia'. You can see cases of this throughout human society. Archon consciousness almost entirely dominates the global banking system and if we study how that system works you will appreciate what I mean. Banks manifest 'money' out of nothing by issuing lines of 'credit' which is 'money' that has never, does not, and will never exist except in theory. It's a confidence trick. If you think 'credit' figures-on-a-screen 'money' is worth anything you accept it as payment. If you don't then the whole system collapses through lack of confidence in the value of that 'money'. Archontic bankers with no 'ennoia' are 'lending' 'money' that doesn't exist to humans that *do* have creativity – those that have the inspired ideas and create businesses and products. Archon banking feeds off human creativity

which it controls through 'money' creation and debt. Humans have the creativity and Archons exploit that for their own benefit and control while having none themselves. Archon Internet platforms like Facebook claim joint copyright of everything that creative users post and while Archontic minds like Zuckerberg may officially head that company it will be human creatives on the staff that provide the creative inspiration. When you have limitless 'money' you can then buy other companies established by creative humans. Witness the acquisition record of Facebook, Google and their like. Survey the Archon-controlled music industry and you see non-creative dark suit executives making their fortune from the human creativity of their artists. The cases are endless. Research the history of people like Gates and Zuckerberg and how their empires were built on exploiting the creativity of others. Archon minds cannot create out of nothing, but they are skilled (because they have to be) in what Gnostic texts call 'countermimicry'. They can imitate, but not innovate. Sabbatians trawl the creativity of others through backdoors they install in computer systems through their cybersecurity systems. Archon-controlled China is globally infamous for stealing intellectual property and I remember how Hong Kong, now part of China, became notorious for making counterfeit copies of the creativity of others – 'countermimicry'. With the now pervasive and all-seeing surveillance systems able to infiltrate any computer you can appreciate the potential for Archons to vampire the creativity of humans. Author John Lamb Lash wrote in his book about the Nag Hammadi texts, *Not In His Image*:

> Although they cannot originate anything, because they lack the divine factor of ennoia (intentionality), Archons can imitate with a vengeance. Their expertise is simulation (HAL, virtual reality). The Demiurge [Yaldabaoth] fashions a heaven world copied from the fractal patterns [of the original] ... His construction is celestial kitsch, like the fake Italianate villa of a Mafia don complete with militant angels to guard every portal.

This brings us to something that I have been speaking about since the turn of the millennium. Our reality is a simulation; a virtual reality that we think is real. No, I'm not kidding.

Human reality? Well, virtually

I had pondered for years about whether our reality is 'real' or some kind of construct. I remembered being immensely affected on a visit as a small child in the late 1950s to the then newly-opened Planetarium on the Marylebone Road in London which is now closed and part of the adjacent Madame Tussauds wax museum. It was in the middle of the day, but when the lights went out there was the night sky projected in the Planetarium's domed ceiling and it appeared to be so real. The experience never left me and I didn't know why until around the turn of the millennium when I became certain that our 'night sky' and entire reality is a projection, a virtual reality, akin to the illusory world portrayed in the *Matrix* movies. I looked at the sky one day in this period and it appeared to me like the domed roof of the Planetarium. The release of the first *Matrix* movie in 1999 also provided a synchronistic and perfect visual representation of where my mind had been going for a long time. I hadn't come across the Gnostic Nag Hammadi texts then. When I did years later the correlation was once again astounding. As I read Gnostic accounts from 1,600 years and more earlier it was clear that they were describing the same simulation phenomenon. They tell how the Yaldabaoth 'Demiurge' and Archons created a 'bad copy' of original reality to rule over all that were captured by its illusions and the body was a prison to trap consciousness in the 'bad copy' fake reality. Read how Gnostics describe the 'bad copy' and update that to current times and they are referring to what we would call today a virtual reality simulation.

Author John Lamb Lash said 'the Demiurge fashions a heaven world copied from the fractal patterns' of the original through expertise in 'HAL' or virtual reality simulation. Fractal patterns are part of the energetic information construct of our reality, a sort of blueprint. If these patterns were copied in computer terms it would indeed give you a copy of a 'natural' reality in a non-natural frequency and digital form. The principle is the same as making a copy of a website. The original website still exists, but now you can change the copy version to make it whatever you like and it can

become very different to the original website. Archons have done this with our reality, a *synthetic* copy of prime reality that still exists beyond the frequency walls of the simulation. Trapped within the illusions of this synthetic Matrix, however, were and are human consciousness and other expressions of prime reality and this is why the Archons via the Cult are seeking to make the human body synthetic and give us synthetic AI minds to complete the job of turning the entire reality synthetic including what we perceive to be the natural world. To quote Kurzweil: 'Nanobots will infuse all the matter around us with information. Rocks, trees, everything will become these intelligent creatures.' Yes, *synthetic* 'creatures' just as 'Covid' and other genetically-manipulating 'vaccines' are designed to make the human body synthetic. From this perspective it is obvious why Archons and their Cult are so desperate to infuse synthetic material into every human with their 'Covid' scam.

Let there be (electromagnetic) light

Yaldabaoth, the force that created the simulation, or Matrix, makes sense of the Gnostic reference to 'The Great Architect' and its use by Cult Freemasonry as the name of its deity. The designer of the Matrix in the movies is called 'The Architect' and that trilogy is jam-packed with symbolism relating to these subjects. I have contended for years that the angry Old Testament God (Yaldabaoth) is the 'God' being symbolically 'quoted' in the opening of Genesis as 'creating the world'. This is not the creation of prime reality – it's the creation of the *simulation*. The Genesis 'God' says: 'Let there be Light: and there was light.' But what is this 'Light'? I have said for decades that the speed of light (186,000 miles per second) is not the fastest speed possible as claimed by mainstream science and is in fact the frequency walls or outer limits of the Matrix. You can't have a fastest or slowest anything within all possibility when everything is possible. The human body is encoded to operate within the speed of light or *within the simulation* and thus we see only the tiny frequency band of visible *light*. Near-death experiencers who perceive reality outside the body during temporary 'death' describe a very different

form of light and this is supported by the Nag Hammadi texts. Prime reality beyond the simulation ('Upper Aeons' to the Gnostics) is described as a realm of incredible beauty, bliss, love and harmony – a realm of 'watery light' that is so powerful 'there are no shadows'. Our false reality of Archon control, which Gnostics call the 'Lower Aeons', is depicted as a realm with a different kind of 'light' and described in terms of chaos, 'Hell', 'the Abyss' and 'Outer Darkness', where trapped souls are tormented and manipulated by demons (relate that to the 'Covid' hoax alone). The watery light theme can be found in near-death accounts and it is not the same as *simulation* 'light' which is electromagnetic or radiation light within the speed of light – the 'Lower Aeons'. Simulation 'light' is the 'luminous fire' associated by Gnostics with the Archons. The Bible refers to Yaldabaoth as 'that old serpent, called the Devil, and Satan, which deceiveth the whole world' (Revelation 12:9). I think that making a simulated copy of prime reality ('countermimicry') and changing it dramatically while all the time manipulating humanity to believe it to be real could probably meet the criteria of deceiving the whole world. Then we come to the Cult god Lucifer – the *Light Bringer*. Lucifer is symbolic of Yaldabaoth, the bringer of radiation light that forms the bad copy simulation within the speed of light. 'He' is symbolised by the lighted torch held by the Statue of Liberty and in the name 'Illuminati'. Sabbatian-Frankism declares that Lucifer is the true god and Lucifer is the real god of Freemasonry honoured as their 'Great or Grand Architect of the Universe' (simulation).

I would emphasise, too, the way Archontic technologically-generated luminous fire of radiation has deluged our environment since I was a kid in the 1950s and changed the nature of The Field with which we constantly interact. Through that interaction technological radiation is changing us. The Smart Grid is designed to operate with immense levels of communication power with 5G expanding across the world and 6G, 7G, in the process of development. Radiation is the simulation and the Archontic manipulation system. Why wouldn't the Archon Cult wish to unleash radiation upon us to an ever-greater extreme to form

Kurzweil's 'cloud'? The plan for a synthetic human is related to the need to cope with levels of radiation beyond even anything we've seen so far. Biological humans would not survive the scale of radiation they have in their script. The Smart Grid is a technological sub-reality within the technological simulation to further disconnect five-sense perception from expanded consciousness. It's a technological prison of the mind.

Infusing the 'spirit of darkness'

A recurring theme in religion and native cultures is the manipulation of human genetics by a non-human force and most famously recorded as the biblical 'sons of god' (the god*s* plural in the original) who interbred with the daughters of men. The Nag Hammadi *Apocryphon of John* tells the same story this way:

> He [Yaldabaoth] sent his angels [Archons/demons] to the daughters of men, that they might take some of them for themselves and raise offspring for their enjoyment. And at first they did not succeed. When they had no success, they gathered together again and they made a plan together ... And the angels changed themselves in their likeness into the likeness of their mates, filling them with the spirit of darkness, which they had mixed for them, and with evil ... And they took women and begot children out of the darkness according to the likeness of their spirit.

Possession when a discarnate entity takes over a human body is an age-old theme and continues today. It's very real and I've seen it. Satanic and secret society rituals can create an energetic environment in which entities can attach to initiates and I've heard many stories of how people have changed their personality after being initiated even into lower levels of the Freemasons. I have been inside three Freemasonic temples, one at a public open day and two by just walking in when there was no one around to stop me. They were in Ryde, the town where I live, Birmingham, England, when I was with a group, and Boston, Massachusetts. They all felt the same energetically – dark, dense, low-vibrational and sinister. Demonic attachment can happen while the initiate has no idea what is going on. To them it's just a ritual to get in the Masons and do a bit of good

business. In the far more extreme rituals of Satanism human possession is even more powerful and they are designed to make possession possible. The hierarchy of the Cult is dictated by the power and perceived status of the possessing Archon. In this way the Archon hierarchy becomes the Cult hierarchy. Once the entity has attached it can influence perception and behaviour and if it attaches to the extreme then so much of its energy (information) infuses into the body information field that the hologram starts to reflect the nature of the possessing entity. This is the *Exorcist* movie type of possession when facial features change and it's known as shapeshifting. Islam's Jinn are said to be invisible tricksters who change shape, 'whisper', confuse and take human form. These are all traits of the Archons and other versions of the same phenomenon. Extreme possession could certainty infuse the 'spirit of darkness' into a partner during sex as the Nag Hammadi texts appear to describe. Such an infusion can change genetics which is also energetic information. Human genetics is information and the 'spirit of darkness' is information. Mix one with the other and change must happen. Islam has the concept of a 'Jinn baby' through possession of the mother and by Jinn taking human form. There are many ways that human genetics can be changed and remember that Archons have been aware all along of advanced techniques to do this. What is being done in human society today – and far more – was known about by Archons at the time of the 'fallen ones' and their other versions described in religions and cultures.

Archons and their human-world Cult are obsessed with genetics as we see today and they know this dictates how information is processed into perceived reality during a human life. They needed to produce a human form that would decode the simulation and this is symbolically known as 'Adam and Eve' who left the 'garden' (prime reality) and 'fell' into Matrix reality. The simulation is not a 'physical' construct (there is no 'physical'); it is a source of information. Think Wi-Fi again. The simulation is an energetic field encoded with information and body-brain systems are designed to decode that information encoded in wave or frequency form which

is transmitted to the brain as electrical signals. These are decoded by the brain to construct our sense of reality – an illusory 'physical' world that only exists in the brain or the mind. Virtual reality games mimic this process using the same sensory decoding system. Information is fed to the senses to decode a virtual reality that can appear so real, but isn't (Figs 18 and 19). Some scientists believe – and I agree with them – that what we perceive as 'physical' reality only exists when we are looking or observing. The act of perception or focus triggers the decoding systems which turn waveform information into holographic reality. When we are not observing something our reality reverts from a holographic state to a waveform state. This relates to the same principle as a falling tree not making a noise unless someone is there to hear it or decode it. The concept makes sense from the simulation perspective. A computer is not decoding all the information in a Wi-Fi field all the time and only decodes or brings into reality on the screen that part of Wi-Fi that it's decoding – focusing upon – at that moment.

Figure 18: Virtual reality technology 'hacks' into the body's five-sense decoding system.

Figure 19: The result can be experienced as very 'real'.

Interestingly, Professor Donald Hoffman at the Department of Cognitive Sciences at the University of California, Irvine, says that our experienced reality is like a computer interface that shows us only the level with which we interact while hiding all that exists beyond it: 'Evolution shaped us with a user interface that hides the truth. Nothing that we see is the truth – the very language of space and time and objects is the wrong language to describe reality.' He is correct in what he says on so many levels. Space and time are not a universal reality. They are a phenomenon of decoded *simulation* reality as part of the process of enslaving our sense of reality. Near-death experiencers report again and again how space and time did not exist as we perceive them once they were free of the body – body decoding systems. You can appreciate from this why Archons and their Cult are so desperate to entrap human attention in the five senses where we are in the Matrix and of the Matrix. Opening your mind to expanded states of awareness takes you beyond the information confines of the simulation and you become aware of knowledge and insights denied to you before. This is what we call 'awakening' – *awakening from the Matrix* – and in the final chapter I will relate this to current events.

Where are the 'aliens'?

A simulation would explain the so-called 'Fermi Paradox' named after Italian physicist Enrico Fermi (1901-1954) who created the first nuclear reactor. He considered the question of why there is such a lack of extraterrestrial activity when there are so many stars and planets in an apparently vast universe; but what if the night sky that we see, or think we do, is a simulated projection as I say? If you control the simulation and your aim is to hold humanity fast in essential ignorance would you want other forms of life including advanced life coming and going sharing information with humanity? Or would you want them to believe they were isolated and apparently alone? Themes of human isolation and apartness are common whether they be the perception of a lifeless universe or the fascist isolation laws of the 'Covid' era. Paradoxically the very

existence of a simulation means that we are not alone when some force had to construct it. My view is that experiences that people have reported all over the world for centuries with Reptilians and Grey entities are Archon phenomena as Nag Hammadi texts describe; and that benevolent 'alien' interactions are non-human groups that come in and out of the simulation by overcoming Archon attempts to keep them out. It should be highlighted, too, that Reptilians and Greys are obsessed with *genetics* and *technology* as related by cultural accounts and those who say they have been abducted by them. Technology is their way of overcoming some of the limitations in their creative potential and our technology-driven and controlled human society of today is *arch*etypical Archon-Reptilian-Grey modus operandi. Technocracy is really *Archon*tocracy. The Universe does not have to be as big as it appears with a simulation. There is no space or distance only information decoded into holographic reality. What we call 'space' is only the absence of holographic 'objects' and that 'space' is The Field of energetic information which connects everything into a single whole. The same applies with the artificially-generated information field of the simulation. The Universe is not big or small as a physical reality. It is decoded information, that's all, and its perceived size is decided by the way the simulation is encoded to make it appear. The entire night sky as we perceive it only exists in our brain and so where are those 'millions of light years'? The 'stars' on the ceiling of the Planetarium looked a vast distance away.

There's another point to mention about 'aliens'. I have been highlighting since the 1990s the plan to stage a fake 'alien invasion' to justify the centralisation of global power and a world military. Nazi scientist Werner von Braun, who was taken to America by Operation Paperclip after World War Two to help found NASA, told his American assistant Dr Carol Rosin about the Cult agenda when he knew he was dying in 1977. Rosin said that he told her about a sequence that would lead to total human control by a one-world government. This included threats from terrorism, rogue nations, meteors and asteroids before finally an 'alien invasion'. All of these

things, von Braun said, would be bogus and what I would refer to as a No-Problem-Reaction-Solution. Keep this in mind when 'the aliens are coming' is the new mantra. The aliens are not coming – they are *already here* and they have infiltrated human society while looking human. French-Canadian investigative journalist Serge Monast said in 1994 that he had uncovered a NASA/military operation called Project Blue Beam which fits with what Werner von Braun predicted. Monast died of a 'heart attack' in 1996 the day after he was arrested and spent a night in prison. He was 51. He said Blue Beam was a plan to stage an alien invasion that would include religious figures beamed holographically into the sky as part of a global manipulation to usher in a 'new age' of worshipping what I would say is the Cult 'god' Yaldabaoth in a one-world religion. Fake holographic asteroids are also said to be part of the plan which again syncs with von Braun. How could you stage an illusory threat from asteroids unless they were holographic inserts? This is pretty straightforward given the advanced technology outside the public arena and the fact that our 'physical' reality is holographic anyway. Information fields would be projected and we would decode them into the illusion of a 'physical' asteroid. If they can sell a global 'pandemic' with a 'virus' that doesn't exist what will humans not believe if government and media tell them?

All this is particularly relevant as I write with the Pentagon planning to release in June, 2021, information about 'UFO sightings'. I have been following the UFO story since the early 1990s and the common theme throughout has been government and military denials and cover up. More recently, however, the Pentagon has suddenly become more talkative and apparently open with Air Force pilot radar images released of unexplained craft moving and changing direction at speeds well beyond anything believed possible with human technology. Then, in March, 2021, former Director of National Intelligence John Ratcliffe said a Pentagon report months later in June would reveal a great deal of information about UFO sightings unknown to the public. He said the report would have 'massive implications'. The order to do this was included bizarrely

in a $2.3 trillion 'coronavirus' relief and government funding bill passed by the Trump administration at the end of 2020. I would add some serious notes of caution here. I have been pointing out since the 1990s that the US military and intelligence networks have long had craft – 'flying saucers' or anti-gravity craft – which any observer would take to be extraterrestrial in origin. Keeping this knowledge from the public allows craft flown by *humans* to be perceived as alien visitations. I am not saying that 'aliens' do not exist. I would be the last one to say that, but we have to be streetwise here. President Ronald Reagan told the UN General Assembly in 1987: 'I occasionally think how quickly our differences worldwide would vanish if we were facing an alien threat from outside this world.' That's the idea. Unite against a common 'enemy' with a common purpose behind your 'saviour force' (the Cult) as this age-old technique of mass manipulation goes global.

Science moves this way …

I could find only one other person who was discussing the simulation hypothesis publicly when I concluded it was real. This was Nick Bostrom, a Swedish-born philosopher at the University of Oxford, who has explored for many years the possibility that human reality is a computer simulation although his version and mine are not the same. Today the simulation and holographic reality hypothesis have increasingly entered the scientific mainstream. Well, the more open-minded mainstream, that is. Here are a few of the ever-gathering examples. American nuclear physicist Silas Beane led a team of physicists at the University of Bonn in Germany pursuing the question of whether we live in a simulation. They concluded that we probably do and it was likely based on a lattice of cubes. They found that cosmic rays align with that specific pattern. The team highlighted the Greisen–Zatsepin–Kuzmin (GZK) limit which refers to cosmic ray particle interaction with cosmic background radiation that creates an apparent boundary for cosmic ray particles. They say in a paper entitled 'Constraints on the Universe as a Numerical Simulation' that this 'pattern of constraint' is exactly what you

would find with a computer simulation. They also made the point that a simulation would create its own 'laws of physics' that would limit possibility. I've been making the same point for decades that the *perceived* laws of physics relate only to this reality, or what I would later call the simulation. When designers write codes to create computer and virtual reality games they are the equivalent of the laws of physics for that game. Players interact within the limitations laid out by the coding. In the same way those who wrote the codes for the simulation decided the laws of physics that would apply. These can be overridden by expanded states of consciousness, but not by those enslaved in only five-sense awareness where simulation codes rule. Overriding the codes is what people call 'miracles'. They are not. They are bypassing the encoded limits of the simulation. A population caught in simulation perception would have no idea that this was their plight. As the Bonn paper said: 'Like a prisoner in a pitch-black cell we would not be able to see the "walls" of our prison,' That's true if people remain mesmerised by the five senses. Open to expanded awareness and those walls become very clear. The main one is the speed of light.

American theoretical physicist James Gates is another who has explored the simulation question and found considerable evidence to support the idea. Gates was Professor of Physics at the University of Maryland, Director of The Center for String and Particle Theory, and on Barack Obama's Council of Advisors on Science and Technology. He and his team found *computer codes* of digital data embedded in the fabric of our reality. They relate to on-off electrical charges of 1 and 0 in the binary system used by computers. 'We have no idea what they are doing there', Gates said. They found within the energetic fabric mathematical sequences known as error-correcting codes or block codes that 'reboot' data to its original state or 'default settings' when something knocks it out of sync. Gates was asked if he had found a set of equations embedded in our reality indistinguishable from those that drive search engines and browsers and he said: 'That is correct.' Rich Terrile, director of the Centre for Evolutionary Computation and Automated Design at NASA's Jet

Propulsion Laboratory, has said publicly that he believes the Universe is a digital hologram that must have been created by a form of intelligence. I agree with that in every way. Waveform information is delivered electrically by the senses to the brain which constructs a *digital* holographic reality that we call the 'world'. This digital level of reality can be read by the esoteric art of numerology. Digital holograms are at the cutting edge of holographics today. We have digital technology everywhere designed to access and manipulate our digital level of perceived reality. Synthetic mRNA in 'Covid vaccines' has a digital component to manipulate the body's digital 'operating system'.

Reality is numbers

How many know that our reality can be broken down to numbers and codes that are the same as computer games? Max Tegmark, a physicist at the Massachusetts Institute of Technology (MIT), is the author of *Our Mathematical Universe* in which he lays out how reality can be entirely described by numbers and maths in the way that a video game is encoded with the 'physics' of computer games. Our world and computer virtual reality are essentially the same. Tegmark imagines the perceptions of characters in an advanced computer game when the graphics are so good they don't know they are in a game. They think they can bump into real objects (electromagnetic resistance in our reality), fall in love and feel emotions like excitement. When they began to study the apparently 'physical world' of the video game they would realise that everything was made of pixels (which have been found in our energetic reality as must be the case when on one level our world is digital). What computer game characters thought was physical 'stuff', Tegmark said, could actually be broken down into numbers:

> And we're exactly in this situation in our world. We look around and it doesn't seem that mathematical at all, but everything we see is made out of elementary particles like quarks and electrons. And what properties does an electron have? Does it have a smell or a colour or a texture? No! ... We physicists have come up with geeky names for [Electron] properties, like

electric charge, or spin, or lepton number, but the electron doesn't care what we call it, the properties are just numbers.

This is the illusory reality Gnostics were describing. This is the simulation. The A, C, G, and T codes of DNA have a binary value – A and C = 0 while G and T = 1. This has to be when the simulation is digital and the body must be digital to interact with it. Recurring mathematical sequences are encoded throughout reality and the body. They include the Fibonacci sequence in which the two previous numbers are added to get the next one, as in ... 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, etc. The sequence is encoded in the human face and body, proportions of animals, DNA, seed heads, pine cones, trees, shells, spiral galaxies, hurricanes and the number of petals in a flower. The list goes on and on. There are fractal patterns – a 'never-ending pattern that is infinitely complex and self-similar across all scales in the as above, so below, principle of holograms. These and other famous recurring geometrical and mathematical sequences such as Phi, Pi, Golden Mean, Golden Ratio and Golden Section are *computer codes* of the simulation. I had to laugh and give my head a shake the day I finished this book and it went into the production stage. I was sent an article in *Scientific American* published in April, 2021, with the headline 'Confirmed! We Live in a Simulation'. Two decades after I first said our reality is a simulation and the speed of light is it's outer limit the article suggested that we do live in a simulation and that the speed of light is its outer limit. I left school at 15 and never passed a major exam in my life while the writer was up to his eyes in qualifications. As I will explain in the final chapter *knowing* is far better than thinking and they come from very different sources. The article rightly connected the speed of light to the processing speed of the 'Matrix' and said what has been in my books all this time … 'If we are in a simulation, as it appears, then space is an abstract property written in code. It is not real'. No it's not and if we live in a simulation something created it and it wasn't *us*. 'That David Icke says we are manipulated by aliens' – he's crackers.'

Wow …

The reality that humanity thinks is so real is an illusion. Politicians, governments, scientists, doctors, academics, law enforcement, media, school and university curriculums, on and on, are all founded on a world that *does not exist* except as a simulated prison cell. Is it such a stretch to accept that 'Covid' doesn't exist when our entire 'physical' reality doesn't exist? Revealed here is the knowledge kept under raps in the Cult networks of compartmentalised secrecy to control humanity's sense of reality by inducing the population to believe in a reality that's not real. If it wasn't so tragic in its experiential consequences the whole thing would be hysterically funny. None of this is new to Renegade Minds. Ancient Greek philosopher Plato (about 428 to about 347BC) was a major influence on Gnostic belief and he described the human plight thousands of years ago with his Allegory of the Cave. He told the symbolic story of prisoners living in a cave who had never been outside. They were chained and could only see one wall of the cave while behind them was a fire that they could not see. Figures walked past the fire casting shadows on the prisoners' wall and those moving shadows became their sense of reality. Some prisoners began to study the shadows and were considered experts on them (today's academics and scientists), but what they studied was only an illusion (today's academics and scientists). A prisoner escaped from the cave and saw reality as it really is. When he returned to report this revelation they didn't believe him, called him mad and threatened to kill him if he tried to set them free. Plato's tale is not only a brilliant analogy of the human plight and our illusory reality. It describes, too, the dynamics of the 'Covid' hoax. I have only skimmed the surface of these subjects here. The aim of this book is to crisply connect all essential dots to put what is happening today into its true context. All subject areas and their connections in this chapter are covered in great evidential detail in *Everything You Need To Know, But Have Never Been Told* and *The Answer*.

They say that bewildered people 'can't see the forest for the trees'. Humanity, however, can't see the forest for the *twigs*. The five senses

see only twigs while Renegade Minds can see the forest and it's the forest where the answers lie with the connections that reveals. Breaking free of perceptual programming so the forest can be seen is the way we turn all this around. Not breaking free is how humanity got into this mess. The situation may seem hopeless, but I promise you it's not. We are a perceptual heartbeat from paradise if only we knew.

CHAPTER TWELVE

Escaping Wetiko

Life is simply a vacation from the infinite
Dean Cavanagh

Renegade Minds weave the web of life and events and see common themes in the apparently random. They are always there if you look for them and their pursuit is aided by incredible synchronicity that comes when your mind is open rather than mesmerised by what it thinks it can see.

Infinite awareness is infinite possibility and the more of infinite possibility that we access the more becomes infinitely possible. That may be stating the apparently obvious, but it is a devastatingly-powerful fact that can set us free. We are a point of attention within an infinity of consciousness. The question is how much of that infinity do we choose to access? How much knowledge, insight, awareness, wisdom, do we want to connect with and explore? If your focus is only in the five senses you will be influenced by a fraction of infinite awareness. I mean a range so tiny that it gives new meaning to infinitesimal. Limitation of self-identity and a sense of the possible limit accordingly your range of consciousness. We are what we think we are. Life is what we think it is. The dream is the dreamer and the dreamer is the dream. Buddhist philosophy puts it this way: 'As a thing is viewed, so it appears.' Most humans live in the realm of touch, taste, see, hear, and smell and that's the limit of their sense of the possible and sense of self. Many will follow a religion and speak of a God in his heaven, but their lives are still

dominated by the five senses in their perceptions and actions. The five senses become the arbiter of everything. When that happens all except a smear of infinity is sealed away from influence by the rigid, unyielding, reality bubbles that are the five-sense human or Phantom Self. Archon Cult methodology is to isolate consciousness within five-sense reality – the simulation – and then program that consciousness with a sense of self and the world through a deluge of life-long information designed to instil the desired perception that allows global control. Efforts to do this have increased dramatically with identity politics as identity bubbles are squeezed into the minutiae of five-sense detail which disconnect people even more profoundly from the infinite 'I'.

Five-sense focus and self-identity are like a firewall that limits access to the infinite realms. You only perceive one radio or television station and no other. We'll take that literally for a moment. Imagine a vast array of stations giving different information and angles on reality, but you only ever listen to one. Here we have the human plight in which the population is overwhelmingly confined to CultFM. This relates only to the frequency range of CultFM and limits perception and insight to that band – limits *possibility* to that band. It means you are connecting with an almost imperceptibly minuscule range of possibility and creative potential within the infinite Field. It's a world where everything seems apart from everything else and where synchronicity is rare. Synchronicity is defined in the dictionary as 'the happening by chance of two or more related or similar events at the same time'. Use of 'by chance' betrays a complete misunderstanding of reality. Synchronicity is not 'by chance'. As people open their minds, or 'awaken' to use the term, they notice more and more coincidences in their lives, bits of 'luck', apparently miraculous happenings that put them in the right place at the right time with the right people. Days become peppered with 'fancy meeting you here' and 'what are the chances of that?' My entire life has been lived like this and ever more so since my own colossal awakening in 1990 and 91 which transformed my sense of reality. Synchronicity is not 'by chance'; it is by accessing expanded

realms of possibility which allow expanded potential for manifestation. People broadcasting the same vibe from the same openness of mind tend to be drawn 'by chance' to each other through what I call frequency magnetism and it's not only people. In the last more than 30 years incredible synchronicity has also led me through the Cult maze to information in so many forms and to crucial personal experiences. These 'coincidences' have allowed me to put the puzzle pieces together across an enormous array of subjects and situations. Those who have breached the bubble of five-sense reality will know exactly what I mean and this escape from the perceptual prison cell is open to everyone whenever they make that choice. This may appear super-human when compared with the limitations of 'human', but it's really our natural state. 'Human' as currently experienced is consciousness in an unnatural state of induced separation from the infinity of the whole. I'll come to how this transformation into unity can be made when I have described in more detail the force that holds humanity in servitude by denying this access to infinite self.

The Wetiko factor

I have been talking and writing for decades about the way five-sense mind is systematically barricaded from expanded awareness. I have used the analogy of a computer (five-sense mind) and someone at the keyboard (expanded awareness). Interaction between the computer and the operator is symbolic of the interaction between five-sense mind and expanded awareness. The computer directly experiences the Internet and the operator experiences the Internet via the computer which is how it's supposed to be – the two working as one. Archons seek to control that point where the operator connects with the computer to stop that interaction (Fig 20). Now the operator is banging the keyboard and clicking the mouse, but the computer is not responding and this happens when the computer is taken over – *possessed* – by an appropriately-named computer 'virus'. The operator has lost all influence over the computer which goes its own way making decisions under the control of the 'virus'. I have

just described the dynamic through which the force known to Gnostics as Yaldabaoth and Archons disconnects five-sense mind from expanded awareness to imprison humanity in perceptual servitude.

Figure 20: The mind 'virus' I have been writing about for decades seeks to isolate five-sense mind (the computer) from the true 'I'. (Image by Neil Hague).

About a year ago I came across a Native American concept of Wetiko which describes precisely the same phenomenon. Wetiko is the spelling used by the Cree and there are other versions including wintiko and windigo used by other tribal groups. They spell the name with lower case, but I see Wetiko as a proper noun as with Archons and prefer a capital. I first saw an article about Wetiko by writer and researcher Paul Levy which so synced with what I had been writing about the computer/operator disconnection and later the Archons. I then read his book, the fascinating *Dispelling Wetiko, Breaking the Spell of Evil*. The parallels between what I had concluded long before and the Native American concept of Wetiko were so clear and obvious that it was almost funny. For Wetiko see the Gnostic Archons for sure and the Jinn, the Predators, and every other name for a force of evil, inversion and chaos. Wetiko is the Native American name for the force that divides the computer from

the operator (Fig 21). Indigenous author Jack D. Forbes, a founder of the Native American movement in the 1960s, wrote another book about Wetiko entitled *Columbus And Other Cannibals – The Wetiko Disease of Exploitation, Imperialism, and Terrorism* which I also read. Forbes says that Wetiko refers to an evil person or spirit 'who terrorizes other creatures by means of terrible acts, including cannibalism'. Zulu shaman Credo Mutwa told me that African accounts tell how cannibalism was brought into the world by the Chitauri 'gods' – another manifestation of Wetiko. The distinction between 'evil person or spirit' relates to Archons/Wetiko possessing a human or acting as pure consciousness. Wetiko is said to be a sickness of the soul or spirit and a state of being that takes but gives nothing back – the Cult and its operatives perfectly described. Black Hawk, a Native American war leader defending their lands from confiscation, said European invaders had 'poisoned hearts' – Wetiko hearts – and that this would spread to native societies. Mention of the heart is very significant as we shall shortly see. Forbes writes: 'Tragically, the history of the world for the past 2,000 years is, in great part, the story of the epidemiology of the wetiko disease.' Yes, and much longer. Forbes is correct when he says: 'The wetikos destroyed Egypt and Babylon and Athens and Rome and Tenochtitlan [capital of the Aztec empire] and perhaps now they will destroy the entire earth.' Evil, he said, is the number one export of a Wetiko culture – see its globalisation with 'Covid'. Constant war, mass murder, suffering of all kinds, child abuse, Satanism, torture and human sacrifice are all expressions of Wetiko and the Wetiko possessed. The world is Wetiko made manifest, *but it doesn't have to be*. There is a way out of this even now.

Figure 21: The mind 'virus' is known to Native Americans as 'Wetiko'. (Image by Neil Hague).

Cult of Wetiko

Wetiko is the Yaldabaoth frequency distortion that seeks to attach to human consciousness and absorb it into its own. Once this connection is made Wetiko can drive the perceptions of the target which they believe to be coming from their own mind. All the horrors of history and today from mass killers to Satanists, paedophiles like Jeffrey Epstein and other psychopaths, are the embodiment of Wetiko and express its state of being in all its grotesqueness. The Cult is Wetiko incarnate, Yaldabaoth incarnate, and it seeks to facilitate Wetiko assimilation of humanity in totality into its distortion by manipulating the population into low frequency states that match its own. Paul Levy writes: 'Holographically enforced within the psyche of every human being the wetiko virus pervades and underlies the entire field of consciousness, and can therefore potentially manifest through any one of us at any moment if we are not mindful.' The 'Covid' hoax has achieved this with many people, but others have not fallen into Wetiko's frequency lair. Players in the 'Covid' human catastrophe including Gates, Schwab, Tedros, Fauci, Whitty, Vallance, Johnson, Hancock, Ferguson, Drosten, and all the rest, including the psychopath psychologists, are expressions of Wetiko. This is why

they have no compassion or empathy and no emotional consequence for what they do that would make them stop doing it. Observe all the people who support the psychopaths in authority against the Pushbackers despite the damaging impact the psychopaths have on their own lives and their family's lives. You are again looking at Wetiko possession which prevents them seeing through the lies to the obvious scam going on. *Why can't they see it?* Wetiko won't let them see it. The perceptual divide that has now become a chasm is between the Wetikoed and the non-Wetikoed.

Paul Levy describes Wetiko in the same way that I have long described the Archontic force. They are the same distorted consciousness operating across dimensions of reality: '… the subtle body of wetiko is not located in the third dimension of space and time, literally existing in another dimension … it is able to affect ordinary lives by mysteriously interpenetrating into our three-dimensional world.' Wetiko does this through its incarnate representatives in the Cult and by weaving itself into The Field which on our level of reality is the electromagnetic information field of the simulation or Matrix. More than that, the simulation *is* Wetiko / Yaldabaoth. Caleb Scharf, Director of Astrobiology at Columbia University, has speculated that 'alien life' could be so advanced that it has transcribed itself into the quantum realm to become what we call physics. He said intelligence indistinguishable from the fabric of the Universe would solve many of its greatest mysteries:

> Perhaps hyper-advanced life isn't just external. Perhaps it's already all around. It is embedded in what we perceive to be physics itself, from the root behaviour of particles and fields to the phenomena of complexity and emergence ... In other words, life might not just be in the equations. It might BE the equations [My emphasis].

Scharf said it is possible that 'we don't recognise advanced life because it forms an integral and unsuspicious part of what we've considered to be the natural world'. I agree. Wetiko/Yaldabaoth *is* the simulation. We are literally in the body of the beast. But that doesn't mean it has to control us. We all have the power to overcome Wetiko

influence and the Cult knows that. I doubt it sleeps too well because it knows that.

Which Field?

This, I suggest, is how it all works. There are two Fields. One is the fierce electromagnetic light of the Matrix within the speed of light; the other is the 'watery light' of The Field beyond the walls of the Matrix that connects with the Great Infinity. Five-sense mind and the decoding systems of the body attach us to the Field of Matrix light. They have to or we could not experience this reality. Five-sense mind sees only the Matrix Field of information while our expanded consciousness is part of the Infinity Field. When we open our minds, and most importantly our hearts, to the Infinity Field we have a mission control which gives us an expanded perspective, a road map, to understand the nature of the five-sense world. If we are isolated only in five-sense mind there is no mission control. We're on our own trying to understand a world that's constantly feeding us information to ensure we do not understand. People in this state can feel 'lost' and bewildered with no direction or radar. You can see ever more clearly those who are influenced by the Fields of Big Infinity or little five-sense mind simply by their views and behaviour with regard to the 'Covid' hoax. We have had this division throughout known human history with the mass of the people on one side and individuals who could see and intuit beyond the walls of the simulation – Plato's prisoner who broke out of the cave and saw reality for what it is. Such people have always been targeted by Wetiko/Archon-possessed authority, burned at the stake or demonised as mad, bad and dangerous. The Cult today and its global network of 'anti-hate', 'anti-fascist' Woke groups are all expressions of Wetiko attacking those exposing the conspiracy, 'Covid' lies and the 'vaccine' agenda.

Woke as a whole is Wetiko which explains its black and white mentality and how at one it is with the Wetiko-possessed Cult. Paul Levy said: 'To be in this paradigm is to still be under the thrall of a two-valued logic – where things are either true or false – of a

wetikoized mind.' Wetiko consciousness is in a permanent rage, therefore so is Woke, and then there is Woke inversion and contradiction. 'Anti-fascists' act like fascists because fascists *and* 'anti-fascists' are both Wetiko at work. Political parties act the same while claiming to be different for the same reason. Secret society and satanic rituals are attaching initiates to Wetiko and the cold, ruthless, psychopathic mentality that secures the positions of power all over the world is Wetiko. Reframing 'training programmes' have the same cumulative effect of attaching Wetiko and we have their graduates described as automatons and robots with a cold, psychopathic, uncaring demeanour. They are all traits of Wetiko possession and look how many times they have been described in this book and elsewhere with regard to personnel behind 'Covid' including the police and medical profession. Climbing the greasy pole in any profession in a Wetiko society requires traits of Wetiko to get there and that is particularly true of politics which is not about fair competition and pre-eminence of ideas. It is founded on how many backs you can stab and arses you can lick. This culminated in the global 'Covid' coordination between the Wetiko possessed who pulled it off in all the different countries without a trace of empathy and compassion for their impact on humans. Our sight sense can see only holographic form and not the Field which connects holographic form. Therefore we perceive 'physical' objects with 'space' in between. In fact that 'space' is energy/consciousness operating on multiple frequencies. One of them is Wetiko and that connects the Cult psychopaths, those who submit to the psychopaths, and those who serve the psychopaths in the media operations of the world. Wetiko is Gates. Wetiko is the mask-wearing submissive. Wetiko is the fake journalist and 'fact-checker'. The Wetiko Field is coordinating the whole thing. Psychopaths, gofers, media operatives, 'anti-hate' hate groups, 'fact-checkers' and submissive people work as one unit *even without human coordination* because they are attached to the *same* Field which is organising it all (Fig 22). Paul Levy is here describing how Wetiko-possessed people are drawn together and refuse to let any information breach their rigid

perceptions. He was writing long before 'Covid', but I think you will recognise followers of the 'Covid' religion *oh just a little bit*:

People who are channelling the vibratory frequency of wetiko align with each other through psychic resonance to reinforce their unspoken shared agreement so as to uphold their deranged view of reality. Once an unconscious content takes possession of certain individuals, it irresistibly draws them together by mutual attraction and knits them into groups tied together by their shared madness that can easily swell into an avalanche of insanity.

A psychic epidemic is a closed system, which is to say that it is insular and not open to any new information or informing influences from the outside world which contradict its fixed, limited, and limiting perspective.

There we have the Woke mind and the 'Covid' mind. Compatible resonance draws the awakening together, too, which is clearly happening today.

Figure 22: The Wetiko Field from which the Cult pyramid and its personnel are made manifest. (Image by Neil Hague).

Spiritual servitude

Wetiko doesn't care about humans. It's not human; it just possesses humans for its own ends and the effect (depending on the scale of

possession) can be anything from extreme psychopathy to unquestioning obedience. Wetiko's worst nightmare is for human consciousness to expand beyond the simulation. Everything is focussed on stopping that happening through control of information, thus perception, thus frequency. The 'education system', media, science, medicine, academia, are all geared to maintaining humanity in five-sense servitude as is the constant stimulation of low-vibrational mental and emotional states (see 'Covid'). Wetiko seeks to dominate those subconscious spaces between five-sense perception and expanded consciousness where the computer meets the operator. From these subconscious hiding places Wetiko speaks to us to trigger urges and desires that we take to be our own and manipulate us into anything from low-vibrational to psychopathic states. Remember how Islam describes the Jinn as invisible tricksters that 'whisper' and confuse. Wetiko is the origin of the 'trickster god' theme that you find in cultures all over the world. Jinn, like the Archons, are Wetiko which is terrified of humans awakening and reconnecting with our true self for then its energy source has gone. With that the feedback loop breaks between Wetiko and human perception that provides the energetic momentum on which its very existence depends as a force of evil. Humans are both its target and its source of survival, but only if we are operating in low-vibrational states of fear, hate, depression and the background anxiety that most people suffer. We are Wetiko's target because we are its key to survival. It needs us, not the other way round. Paul Levy writes:

A vampire has no intrinsic, independent, substantial existence in its own right; it only exists in relation to us. The pathogenic, vampiric mind-parasite called wetiko is nothing in itself – not being able to exist from its own side – yet it has a 'virtual reality' such that it can potentially destroy our species …

…The fact that a vampire is not reflected by a mirror can also mean that what we need to see is that there's nothing, no-thing to see, other than ourselves. The fact that wetiko is the expression of something inside of us means that the cure for wetiko is with us as well. The critical issue is finding this cure within us and then putting it into effect.

Evil begets evil because if evil does not constantly expand and find new sources of energetic sustenance its evil, its *distortion*, dies with the assimilation into balance and harmony. Love is the garlic to Wetiko's vampire. Evil, the absence of love, cannot exist in the presence of love. I think I see a way out of here. I have emphasised so many times over the decades that the Archons/Wetiko and their Cult are not all powerful. *They are not*. I don't care how it looks even now *they are not*. I have not called them little boys in short trousers for effect. I have said it because it is true. Wetiko's insatiable desire for power over others is not a sign of its omnipotence, but its insecurity. Paul Levy writes: 'Due to the primal fear which ultimately drives it and which it is driven to cultivate, wetiko's body politic has an intrinsic and insistent need for centralising power and control so as to create imagined safety for itself.' *Yeeeeeees!* Exactly! Why does Wetiko want humans in an ongoing state of fear? Wetiko itself *is* fear and it is petrified of love. As evil is an absence of love, so love is an absence of fear. Love conquers all and *especially* Wetiko which *is* fear. Wetiko brought fear into the world when it wasn't here before. *Fear* was the 'fall', the fall into low-frequency ignorance and illusion – fear is **F**alse **E**motion **A**ppearing **R**eal. The simulation is driven and energised by fear because Wetiko/Yaldabaoth (fear) *are* the simulation. Fear is the absence of love and Wetiko is the absence of love.

Wetiko today

We can now view current events from this level of perspective. The 'Covid' hoax has generated momentous amounts of ongoing fear, anxiety, depression and despair which have empowered Wetiko. No wonder people like Gates have been the instigators when they are Wetiko incarnate and exhibit every trait of Wetiko in the extreme. See how cold and unemotional these people are like Gates and his cronies, how dead of eye they are. That's Wetiko. Sabbatians are Wetiko and everything they control including the World Health Organization, Big Pharma and the 'vaccine' makers, national 'health'

hierarchies, corporate media, Silicon Valley, the banking system, and the United Nations with its planned transformation into world government. All are controlled and possessed by the Wetiko distortion into distorting human society in its image. We are with this knowledge at the gateway to understanding the world. Divisions of race, culture, creed and sexuality are diversions to hide the real division between those possessed and influenced by Wetiko and those that are not. The 'Covid' hoax has brought both clearly into view. Human behaviour is not about race. Tyrants and dictatorships come in all colours and creeds. What unites the US president bombing the innocent and an African tribe committing genocide against another as in Rwanda? What unites them? *Wetiko*. All wars are Wetiko, all genocide is Wetiko, all hunger over centuries in a world of plenty is Wetiko. Children going to bed hungry, including in the West, is Wetiko. Cult-generated Woke racial divisions that focus on the body are designed to obscure the reality that divisions in behaviour are manifestations of mind, not body. Obsession with body identity and group judgement is a means to divert attention from the real source of behaviour – mind and perception. Conflict sown by the Woke both within themselves and with their target groups are Wetiko providing lunch for itself through still more agents of the division, chaos, and fear on which it feeds. The Cult is seeking to assimilate the entirety of humanity and all children and young people into the Wetiko frequency by manipulating them into states of fear and despair. Witness all the suicide and psychological unravelling since the spring of 2020. Wetiko psychopaths want to impose a state of unquestioning obedience to authority which is no more than a conduit for Wetiko to enforce its will and assimilate humanity into itself. It needs us to believe that resistance is futile when it fears resistance and even more so the game-changing non-cooperation with its impositions. It can use violent resistance for its benefit. Violent impositions and violent resistance are *both* Wetiko. The Power of Love with its Power of No will sweep Wetiko from our world. Wetiko and its Cult know that. They just don't want us to know.

AI Wetiko

This brings me to AI or artificial intelligence and something else Wetikos don't want us to know. What is AI *really*? I know about computer code algorithms and AI that learns from data input. These, however, are more diversions, the expeditionary force, for the real AI that they want to connect to the human brain as promoted by Silicon Valley Wetikos like Kurzweil. What is this AI? It is the frequency of *Wetiko*, the frequency of the Archons. The connection of AI to the human brain is the connection of the Wetiko frequency to create a Wetiko hive mind and complete the job of assimilation. The hive mind is planned to be controlled from Israel and China which are both 100 percent owned by Wetiko Sabbatians. The assimilation process has been going on minute by minute in the 'smart' era which fused with the 'Covid' era. We are told that social media is scrambling the minds of the young and changing their personality. This is true, but what is social media? Look more deeply at how it works, how it creates divisions and conflict, the hostility and cruelty, the targeting of people until they are destroyed. That's Wetiko. Social media is manipulated to tune people to the Wetiko frequency with all the emotional exploitation tricks employed by platforms like Facebook and its Wetiko front man, Zuckerberg. Facebook's Instagram announced a new platform for children to overcome a legal bar on them using the main site. This is more Wetiko exploitation and manipulation of kids. Amnesty International likened the plan to foxes offering to guard the henhouse and said it was incompatible with human rights. Since when did Wetiko or Zuckerberg (I repeat myself) care about that? Would Brin and Page at Google, Wojcicki at YouTube, Bezos at Amazon and whoever the hell runs Twitter act as they do if they were not channelling Wetiko? Would those who are developing technologies for no other reason than human control? How about those designing and selling technologies to kill people and Big Pharma drug and 'vaccine' producers who know they will end or devastate lives? Quite a thought for these people to consider is that if you are Wetiko in a human life you are Wetiko on the 'other side' unless your frequency

changes and that can only change by a change of perception which becomes a change of behaviour. Where Gates is going does not bear thinking about although perhaps that's exactly where he wants to go. Either way, that's where he's going. His frequency will make it so.

The frequency lair

I have been saying for a long time that a big part of the addiction to smartphones and devices is that a frequency is coming off them that entraps the mind. People spend ages on their phones and sometimes even a minute or so after they put them down they pick them up again and it all repeats. 'Covid' lockdowns will have increased this addiction a million times for obvious reasons. Addictions to alcohol overindulgence and drugs are another way that Wetiko entraps consciousness to attach to its own. Both are symptoms of low-vibrational psychological distress which alcoholism and drug addiction further compound. Do we think it's really a coincidence that access to them is made so easy while potions that can take people into realms beyond the simulation are banned and illegal? I have explored smartphone addiction in other books, the scale is mind-blowing, and that level of addiction does not come without help. Tech companies that make these phones are Wetiko and they will have no qualms about destroying the minds of children. We are seeing again with these companies the Wetiko perceptual combination of psychopathic enforcers and weak and meek unquestioning compliance by the rank and file.

The global Smart Grid is the Wetiko Grid and it is crucial to complete the Cult endgame. The simulation is radiation and we are being deluged with technological radiation on a devastating scale. Wetiko frauds like Elon Musk serve Cult interests while occasionally criticising them to maintain his street-cred. 5G and other forms of Wi-Fi are being directed at the earth from space on a volume and scale that goes on increasing by the day. Elon Musk's (officially) SpaceX Starlink project is in the process of putting tens of thousands of satellites in low orbit to cover every inch of the planet with 5G and other Wi-Fi to create Kurzweil's global 'cloud' to which the

human mind is planned to be attached very soon. SpaceX has approval to operate 12,000 satellites with more than 1,300 launched at the time of writing and applications filed for *30,000* more. Other operators in the Wi-Fi, 5G, low-orbit satellite market include OneWeb (UK), Telesat (Canada), and AST & Science (US). Musk tells us that AI could be the end of humanity and then launches a company called Neuralink to connect the human brain to computers. Musk's (in theory) Tesla company is building electric cars and the driverless vehicles of the smart control grid. As frauds and bullshitters go Elon Musk in my opinion is Major League.

5G and technological radiation in general are destructive to human health, genetics and psychology and increasing the strength of artificial radiation underpins the five-sense perceptual bubbles which are themselves expressions of radiation or electromagnetism. Freedom activist John Whitehead was so right with his 'databit by databit, we are building our own electronic concentration camps'. The Smart Grid and 5G is a means to control the human mind and infuse perceptual information into The Field to influence anyone in sync with its frequency. You can change perception and behaviour en masse if you can manipulate the population into those levels of frequency and this is happening all around us today. The arrogance of Musk and his fellow Cult operatives knows no bounds in the way that we see with Gates. Musk's satellites are so many in number already they are changing the night sky when viewed from Earth. The astronomy community has complained about this and they have seen nothing yet. Some consequences of Musk's Wetiko hubris include: Radiation; visible pollution of the night sky; interference with astronomy and meteorology; ground and water pollution from intensive use of increasingly many spaceports; accumulating space debris; continual deorbiting and burning up of aging satellites, polluting the atmosphere with toxic dust and smoke; and ever-increasing likelihood of collisions. A collective public open letter of complaint to Musk said:

> We are writing to you … because SpaceX is in process of surrounding the Earth with a network of thousands of satellites whose very purpose is to irradiate every square inch of the

Earth. SpaceX, like everyone else, is treating the radiation as if it were not there. As if the mitochondria in our cells do not depend on electrons moving undisturbed from the food we digest to the oxygen we breathe.

As if our nervous systems and our hearts are not subject to radio frequency interference like any piece of electronic equipment. As if the cancer, diabetes, and heart disease that now afflict a majority of the Earth's population are not metabolic diseases that result from interference with our cellular machinery. As if insects everywhere, and the birds and animals that eat them, are not starving to death as a result.

People like Musk and Gates believe in their limitless Wetiko arrogance that they can do whatever they like to the world because they own it. Consequences for humanity are irrelevant. It's absolutely time that we stopped taking this shit from these self-styled masters of the Earth when you consider where this is going.

Why is the Cult so anti-human?

I hear this question often: Why would they do this when it will affect them, too? Ah, but will it? Who is this *them*? Forget their bodies. They are just vehicles for Wetiko consciousness. When you break it all down to the foundations we are looking at a state of severely distorted consciousness targeting another state of consciousness for assimilation. The rest is detail. The simulation is the fly-trap in which unique sensations of the five senses create a cycle of addiction called reincarnation. Renegade Minds see that everything which happens in our reality is a smaller version of the whole picture in line with the holographic principle. Addiction to the radiation of smart technology is a smaller version of addiction to the whole simulation. Connecting the body/brain to AI is taking that addiction on a giant step further to total ongoing control by assimilating human incarnate consciousness into Wetiko. I have watched during the 'Covid' hoax how many are becoming ever more profoundly attached to Wetiko's perceptual calling cards of aggressive response to any other point of view ('There is no other god but me'), psychopathic lack of compassion and empathy, and servile submission to the narrative and will of authority. Wetiko is the psychopaths *and* subservience to psychopaths. The Cult of Wetiko is

so anti-human because it is *not* human. It embarked on a mission to destroy human by targeting everything that it means to be human and to survive as human. 'Covid' is not the end, just a means to an end. The Cult with its Wetiko consciousness is seeking to change Earth systems, including the atmosphere, to suit them, not humans. The gathering bombardment of 5G alone from ground and space is dramatically changing The Field with which the five senses interact. There is so much more to come if we sit on our hands and hope it will all go away. It is not meant to go away. It is meant to get ever more extreme and we need to face that while we still can – just.

Carbon dioxide is the gas of life. Without that human is over. Kaput, gone, history. No natural world, no human. The Cult has created a cock and bull story about carbon dioxide and climate change to justify its reduction to the point where Gates and the ignoramus Biden 'climate chief' John Kerry want to suck it out of the atmosphere. Kerry wants to do this because his master Gates does. Wetikos have made the gas of life a demon with the usual support from the Wokers of Extinction Rebellion and similar organisations and the bewildered puppet-child that is Greta Thunberg who was put on the world stage by Klaus Schwab and the World Economic Forum. The name Extinction Rebellion is both ironic and as always Wetiko inversion. The gas that we need to survive must be reduced to save us from extinction. The most basic need of human is oxygen and we now have billions walking around in face nappies depriving body and brain of this essential requirement of human existence. More than that 5G at 60 gigahertz interacts with the oxygen molecule to reduce the amount of oxygen the body can absorb into the bloodstream. The obvious knock-on consequences of that for respiratory and cognitive problems and life itself need no further explanation. Psychopaths like Musk are assembling a global system of satellites to deluge the human atmosphere with this insanity. The man should be in jail. Here we have two most basic of human needs, oxygen and carbon dioxide, being dismantled.

Two others, water and food, are getting similar treatment with the United Nations Agendas 21 and 2030 – the Great Reset – planning to

centrally control all water and food supplies. People will not even own rain water that falls on their land. Food is affected at the most basic level by reducing carbon dioxide. We have genetic modification or GMO infiltrating the food chain on a mass scale, pesticides and herbicides polluting the air and destroying the soil. Freshwater fish that provide livelihoods for 60 million people and feed hundreds of millions worldwide are being 'pushed to the brink' according the conservationists while climate change is the only focus. Now we have Gates and Schwab wanting to dispense with current food sources all together and replace them with a synthetic version which the Wetiko Cult would control in terms of production and who eats and who doesn't. We have been on the Totalitarian Tiptoe to this for more than 60 years as food has become ever more processed and full of chemical shite to the point today when it's not natural food at all. As Dr Tom Cowan says: 'If it has a label don't eat it.' Bill Gates is now the biggest owner of farmland in the United States and he does nothing without an ulterior motive involving the Cult. Klaus Schwab wrote: 'To feed the world in the next 50 years we will need to produce as much food as was produced in the last 10,000 years … food security will only be achieved, however, if regulations on genetically modified foods are adapted to reflect the reality that gene editing offers a precise, efficient and safe method of improving crops.' Liar. People and the world are being targeted with aluminium through vaccines, chemtrails, food, drink cans, and endless other sources when aluminium has been linked to many health issues including dementia which is increasing year after year. Insects, bees and wildlife essential to the food chain are being deleted by pesticides, herbicides and radiation which 5G is dramatically increasing with 6G and 7G to come. The pollinating bee population is being devastated while wildlife including birds, dolphins and whales are having their natural radar blocked by the effects of ever-increasing radiation. In the summer windscreens used to be splattered with insects so numerous were they. It doesn't happen now. Where have they gone?

Synthetic everything

The Cult is introducing genetically-modified versions of trees, plants and insects including a Gates-funded project to unleash hundreds of millions of genetically-modified, lab-altered and patented male mosquitoes to mate with wild mosquitoes and induce genetic flaws that cause them to die out. Clinically-insane Gates-funded Japanese researchers have developed mosquitos that spread vaccine and are dubbed 'flying vaccinators'. Gates is funding the modification of weather patterns in part to sell the myth that this is caused by carbon dioxide and he's funding geoengineering of the skies to change the atmosphere. Some of this came to light with the Gates-backed plan to release tonnes of chalk into the atmosphere to 'deflect the Sun and cool the planet'. Funny how they do this while the heating effect of the Sun is not factored into climate projections focussed on carbon dioxide. The reason is that they want to reduce carbon dioxide (so don't mention the Sun), but at the same time they do want to reduce the impact of the Sun which is so essential to human life and health. I have mentioned the sun-cholesterol-vitamin D connection as they demonise the Sun with warnings about skin cancer (caused by the chemicals in sun cream they tell you to splash on). They come from the other end of the process with statin drugs to reduce cholesterol that turns sunlight into vitamin D. A lack of vitamin D leads to a long list of health effects and how vitamin D levels must have fallen with people confined to their homes over 'Covid'. Gates is funding other forms of geoengineering and most importantly chemtrails which are dropping heavy metals, aluminium and self-replicating nanotechnology onto the Earth which is killing the natural world. See *Everything You Need To Know, But Have Never Been Told* for the detailed background to this.

Every human system is being targeted for deletion by a force that's not human. The Wetiko Cult has embarked on the process of transforming the human body from biological to synthetic biological as I have explained. Biological is being replaced by the artificial and synthetic – Archontic 'countermimicry' – right across human society. The plan eventually is to dispense with the human body altogether

and absorb human consciousness – which it wouldn't really be by then – into cyberspace (the simulation which is Wetiko/Yaldabaoth). Preparations for that are already happening if people would care to look. The alternative media rightly warns about globalism and 'the globalists', but this is far bigger than that and represents the end of the human race as we know it. The 'bad copy' of prime reality that Gnostics describe was a bad copy of harmony, wonder and beauty to start with before Wetiko/Yaldabaoth set out to change the simulated 'copy' into something very different. The process was slow to start with. Entrapped humans in the simulation timeline were not technologically aware and they had to be brought up to intellectual speed while being suppressed spiritually to the point where they could build their own prison while having no idea they were doing so. We have now reached that stage where technological intellect has the potential to destroy us and that's why events are moving so fast. Central American shaman Don Juan Matus said:

> Think for a moment, and tell me how you would explain the contradictions between the intelligence of man the engineer and the stupidity of his systems of belief, or the stupidity of his contradictory behaviour. Sorcerers believe that the predators have given us our systems of beliefs, our ideas of good and evil; our social mores. They are the ones who set up our dreams of success or failure. They have given us covetousness, greed, and cowardice. It is the predator who makes us complacent, routinary, and egomaniacal.
>
> In order to keep us obedient and meek and weak, the predators engaged themselves in a stupendous manoeuvre – stupendous, of course, from the point of view of a fighting strategist; a horrendous manoeuvre from the point of those who suffer it. They gave us their mind. The predators' mind is baroque, contradictory, morose, filled with the fear of being discovered any minute now.

For 'predators' see Wetiko, Archons, Yaldabaoth, Jinn, and all the other versions of the same phenomenon in cultures and religions all over the world. The theme is always the same because it's true and it's real. We have reached the point where we have to deal with it. The question is – how?

Don't fight – walk away

I thought I'd use a controversial subheading to get things moving in terms of our response to global fascism. What do you mean 'don't fight'? What do you mean 'walk away'? We've got to fight. We can't walk away. Well, it depends what we mean by fight and walk away. If fighting means physical combat we are playing Wetiko's game and falling for its trap. It wants us to get angry, aggressive, and direct hate and hostility at the enemy we think we must fight. Every war, every battle, every conflict, has been fought with Wetiko leading both sides. It's what it does. Wetiko wants a fight, anywhere, any place. Just hit me, son, so I can hit you back. Wetiko hits Wetiko and Wetiko hits Wetiko in return. I am very forthright as you can see in exposing Wetikos of the Cult, but I don't hate them. I refuse to hate them. It's what they want. What you hate you become. What you *fight* you become. Wokers, 'anti-haters' and 'anti-fascists' prove this every time they reach for their keyboards or don their balaclavas. By walk away I mean to disengage from Wetiko which includes ceasing to cooperate with its tyranny. Paul Levy says of Wetiko:

> The way to 'defeat' evil is not to try to destroy it (for then, in playing evil's game, we have already lost), but rather, to find the invulnerable place within ourselves where evil is unable to vanquish us – this is to truly 'win' our battle with evil.

Wetiko is everywhere in human society and it's been on steroids since the 'Covid' hoax. Every shouting match over wearing masks has Wetiko wearing a mask and Wetiko not wearing one. It's an electrical circuit of push and resist, push and resist, with Wetiko pushing *and* resisting. Each polarity is Wetiko empowering itself. Dictionary definitions of 'resist' include 'opposing, refusing to accept or comply with' and the word to focus on is 'opposing'. What form does this take – setting police cars alight or 'refusing to accept or comply with'? The former is Wetiko opposing Wetiko while the other points the way forward. This is the difference between those aggressively demanding that government fascism must be obeyed who stand in stark contrast to the great majority of Pushbackers. We saw this clearly with a march by thousands of Pushbackers against lockdown in London followed days later by a Woker-hijacked

protest in Bristol in which police cars were set on fire. Masks were virtually absent in London and widespread in Bristol. Wetiko wants lockdown on every level of society and infuses its aggression to police it through its unknowing stooges. Lockdown protesters are the ones with the smiling faces and the hugs, The two blatantly obvious states of being – getting more obvious by the day – are the result of Wokers and their like becoming ever more influenced by the simulation Field of Wetiko and Pushbackers ever more influenced by The Field of a far higher vibration beyond the simulation. Wetiko can't invade the heart which is where most lockdown opponents are coming from. It's the heart that allows them to see through the lies to the truth in ways I will be highlighting.

Renegade Minds know that calmness is the place from which wisdom comes. You won't find wisdom in a hissing fit and wisdom is what we need in abundance right now. Calmness is not weakness – you don't have to scream at the top of your voice to be strong. Calmness is indeed a sign of strength. 'No' means I'm not doing it. *NOOOO!!!* doesn't mean you're not doing it even more. Volume does not advance 'No – I'm not doing it'. You are just not doing it. Wetiko possessed and influenced don't know how to deal with that. Wetiko wants a fight and we should not give it one. What it needs more than anything is our *cooperation* and we should not give that either. Mass rallies and marches are great in that they are a visual representation of feeling, but if it ends there they are irrelevant. You demand that Wetikos act differently? Well, they're not going to are they? They are Wetikos. We don't need to waste our time demanding that something doesn't happen when that will make no difference. We need to delete the means that *allows* it to happen. This, invariably, is our cooperation. You can demand a child stop firing a peashooter at the dog or you can refuse to buy the peashooter. If you provide the means you are cooperating with the dog being smacked on the nose with a pea. How can the authorities enforce mask-wearing if millions in a country refuse? What if the 74 million Pushbackers that voted for Trump in 2020 refused to wear masks, close their businesses or stay in their homes. It would be unenforceable. The

few control the many through the compliance of the many and that's always been the dynamic be it 'Covid' regulations or the Roman Empire. I know people can find it intimidating to say no to authority or stand out in a crowd for being the only one with a face on display; but it has to be done or it's over. I hope I've made clear in this book that where this is going will be far more intimidating than standing up now and saying 'No' – I will not cooperate with my own enslavement and that of my children. There might be consequences for some initially, although not so if enough do the same. The question that must be addressed is what is going to happen if we don't? It is time to be strong and unyieldingly so. No means no. Not here and there, but *everywhere* and *always*. I have refused to wear a mask and obey all the other nonsense. I will not comply with tyranny. I repeat: Fascism is not imposed by fascists – there are never enough of them. Fascism is imposed by the population acquiescing to fascism. *I will not do it*. I will die first, or my body will. Living meekly under fascism is a form of death anyway, the death of the spirit that Martin Luther King described.

Making things happen

We must not despair. This is not over till it's over and it's far from that. The 'fat lady' must refuse to sing. The longer the 'Covid' hoax has dragged on and impacted on more lives we have seen an awakening of phenomenal numbers of people worldwide to the realisation that what they have believed all their lives is not how the world really is. Research published by the system-serving University of Bristol and King's College London in February, 2021, concluded: 'One in every 11 people in Britain say they trust David Icke's take on the coronavirus pandemic.' It will be more by now and we have gathering numbers to build on. We must urgently progress from seeing the scam to ceasing to cooperate with it. Prominent German lawyer Reiner Fuellmich, also licenced to practice law in America, is doing a magnificent job taking the legal route to bring the psychopaths to justice through a second Nuremberg tribunal for crimes against humanity. Fuellmich has an impressive record of

beating the elite in court and he formed the German Corona Investigative Committee to pursue civil charges against the main perpetrators with a view to triggering criminal charges. Most importantly he has grasped the foundation of the hoax – the PCR test not testing for the 'virus' – and Christian Drosten is therefore on his charge sheet along with Gates frontman Tedros at the World Health Organization. Major players must be not be allowed to inflict their horrors on the human race without being brought to book. A life sentence must follow for Bill Gates and the rest of them. A group of researchers has also indicted the government of Norway for crimes against humanity with copies sent to the police and the International Criminal Court. The lawsuit cites participation in an internationally-planned false pandemic and violation of international law and human rights, the European Commission's definition of human rights by coercive rules, Nuremberg and Hague rules on fundamental human rights, and the Norwegian constitution. We must take the initiative from hereon and not just complain, protest and react.

There are practical ways to support vital mass non-cooperation. Organising in numbers is one. Lockdown marches in London in the spring in 2021 were mass non-cooperation that the authorities could not stop. There were too many people. Hundreds of thousands walked the London streets in the centre of the road for mile after mile while the Face-Nappies could only look on. They were determined, but calm, and just *did it* with no histrionics and lots of smiles. The police were impotent. Others are organising group shopping without masks for mutual support and imagine if that was happening all over. Policing it would be impossible. If the store refuses to serve people in these circumstances they would be faced with a long line of trolleys full of goods standing on their own and everything would have to be returned to the shelves. How would they cope with that if it kept happening? I am talking here about moving on from complaining to being pro-active; from watching things happen to making things happen. I include in this our relationship with the police. The behaviour of many Face-Nappies

has been disgraceful and anyone who thinks they would never find concentration camp guards in the 'enlightened' modern era have had that myth busted big-time. The period and setting may change – Wetikos never do. I watched film footage from a London march in which a police thug viciously kicked a protestor on the floor who had done nothing. His fellow Face-Nappies stood in a ring protecting him. What he did was a criminal assault and with a crowd far outnumbering the police this can no longer be allowed to happen unchallenged. I get it when people chant 'shame on you' in these circumstances, but that is no longer enough. They *have* no shame those who do this. Crowds needs to start making a citizen's arrest of the police who commit criminal offences and brutally attack innocent people and defenceless women. A citizen's arrest can be made under section 24A of the UK Police and Criminal Evidence (PACE) Act of 1984 and you will find something similar in other countries. I prefer to call it a Common Law arrest rather than citizen's for reasons I will come to shortly. Anyone can arrest a person committing an indictable offence or if they have reasonable grounds to suspect they are committing an indictable offence. On both counts the attack by the police thug would have fallen into this category. A citizen's arrest can be made to stop someone:

- Causing physical injury to himself or any other person
- Suffering physical injury
- Causing loss of or damage to property
- Making off before a constable can assume responsibility for him

A citizen's arrest may also be made to prevent a breach of the peace under Common Law and if they believe a breach of the peace will happen or anything related to harm likely to be done or already done in their presence. This is the way to go I think – the Common Law version. If police know that the crowd and members of the public will no longer be standing and watching while they commit

their thuggery and crimes they will think twice about acting like Brownshirts and Blackshirts.

Common Law – common sense

Mention of Common Law is very important. Most people think the law is the law as in one law. This is not the case. There are two bodies of law, Common Law and Statute Law, and they are not the same. Common Law is founded on the simple premise of do no harm. It does not recognise victimless crimes in which no harm is done while Statute Law does. There is a Statute Law against almost everything. So what is Statute Law? Amazingly it's the law of the *sea* that was brought ashore by the Cult to override the law of the land which is Common Law. They had no right to do this and as always they did it anyway. They had to. They could not impose their will on the people through Common Law which only applies to do no harm. How could you stitch up the fine detail of people's lives with that? Instead they took the law of the sea, or Admiralty Law, and applied it to the population. Statute Law refers to all the laws spewing out of governments and their agencies including all the fascist laws and regulations relating to 'Covid'. The key point to make is that Statute Law is *contract law*. It only applies between *contracting* corporations. Most police officers don't even know this. They have to be kept in the dark, too. Long ago when merchants and their sailing ships began to trade with different countries a contractual law was developed called Admiralty Law and other names. Again it only applied to *contracts* agreed between *corporate* entities. If there is no agreed contract the law of the sea had no jurisdiction *and that still applies to its new alias of Statute Law*. The problem for the Cult when the law of the sea was brought ashore was an obvious one. People were not corporations and neither were government entities. To overcome the latter they made governments and all associated organisations corporations. All the institutions are *private corporations* and I mean governments and their agencies, local councils, police, courts, military, US states, the whole lot. Go to the

Dun and Bradstreet corporate listings website for confirmation that they are all corporations. You are arrested by a private corporation called the police by someone who is really a private security guard and they take you to court which is another private corporation. Neither have jurisdiction over you unless you consent and *contract* with them. This is why you hear the mantra about law enforcement policing by *consent* of the people. In truth the people 'consent' only in theory through monumental trickery.

Okay, the Cult overcame the corporate law problem by making governments and institutions corporate entities; but what about people? They are not corporations are they? Ah ... well in a sense, and *only* a sense, they are. Not people exactly – the illusion of people. The Cult creates a corporation in the name of everyone at the time that their birth certificate is issued. Note birth/ *berth* certificate and when you go to court under the law of the sea on land you stand in a *dock*. These are throwbacks to the origin. My Common Law name is David Vaughan Icke. The name of the corporation created by the government when I was born is called Mr David Vaughan Icke usually written in capitals as MR DAVID VAUGHAN ICKE. That is not me, the living, breathing man. It is a fictitious corporate entity. The trick is to make you think that David Vaughan Icke and MR DAVID VAUGHAN ICKE are the same thing. *They are not*. When police charge you and take you to court they are prosecuting the corporate entity and not the living, breathing, man or woman. They have to trick you into identifying as the corporate entity and contracting with them. Otherwise they have no jurisdiction. They do this through a language known as legalese. Lawful and legal are not the same either. Lawful relates to Common Law and legal relates to Statute Law. Legalese is the language of Statue Law which uses terms that mean one thing to the public and another in legalese. Notice that when a police officer tells someone why they are being charged he or she will say at the end: 'Do you understand?' To the public that means 'Do you comprehend?' In legalese it means 'Do you stand under me?' Do you stand under my authority? If you say

yes to the question you are unknowingly agreeing to give them jurisdiction over you in a contract between two corporate entities.

This is a confidence trick in every way. Contracts have to be agreed between informed parties and if you don't know that David Vaughan Icke is agreeing to be the corporation MR DAVID VAUGHAN ICKE you cannot knowingly agree to contract. They are deceiving you and another way they do this is to ask for proof of identity. You usually show them a driving licence or other document on which your corporate name is written. In doing so you are accepting that you are that corporate entity when you are not. Referring to yourself as a 'person' or 'citizen' is also identifying with your corporate fiction which is why I made the Common Law point about the citizen's arrest. If you are approached by a police officer you identify yourself immediately as a living, breathing, man or woman and say 'I do not consent, I do not contract with you and I do not understand' or stand under their authority. I have a Common Law birth certificate as a living man and these are available at no charge from commonlawcourt.com. Businesses registered under the Statute Law system means that its laws apply. There are, however, ways to run a business under Common Law. Remember all 'Covid' laws and regulations are Statute Law – the law of *contracts* and you do not have to contract. This doesn't mean that you can kill someone and get away with it. Common Law says do no harm and that applies to physical harm, financial harm etc. Police are employees of private corporations and there needs to be a new system of non-corporate Common Law constables operating outside the Statute Law system. If you go to davidicke.com and put Common Law into the search engine you will find videos that explain Common Law in much greater detail. It is definitely a road we should walk.

With all my heart

I have heard people say that we are in a spiritual war. I don't like the term 'war' with its Wetiko dynamic, but I know what they mean. Sweep aside all the bodily forms and we are in a situation in which two states of consciousness are seeking very different realities.

Wetiko wants upheaval, chaos, fear, suffering, conflict and control. The other wants love, peace, harmony, fairness and freedom. That's where we are. We should not fall for the idea that Wetiko is all-powerful and there's nothing we can do. Wetiko is not all-powerful. It's a joke, pathetic. It doesn't have to be, but it has made that choice for now. A handful of times over the years when I have felt the presence of its frequency I have allowed it to attach briefly so I could consciously observe its nature. The experience is not pleasant, the energy is heavy and dark, but the ease with which you can kick it back out the door shows that its real power is in persuading us that it has power. It's all a con. Wetiko is a con. It's a trickster and not a power that can control us if we unleash our own. The con is founded on manipulating humanity to give its power to Wetiko which recycles it back to present the illusion that it has power when its power is *ours* that we gave away. This happens on an energetic level and plays out in the world of the seen as humanity giving its power to Wetiko authority which uses that power to control the population when the power is only the power the population has handed over. How could it be any other way for billions to be controlled by a relative few? I have had experiences with people possessed by Wetiko and again you can kick its arse if you do it with an open heart. Oh yes – the *heart* which can transform the world of perceived 'matter'.

We are receiver-transmitters and processors of information, but what information and where from? Information is processed into perception in three main areas – the brain, the heart and the belly. These relate to thinking, knowing, and emotion. Wetiko wants us to be head and belly people which means we think within the confines of the Matrix simulation and low-vibrational emotional reaction scrambles balance and perception. A few minutes on social media and you see how emotion is the dominant force. Woke is all emotion and is therefore thought-free and fact-free. Our heart is something different. It *knows* while the head *thinks* and has to try to work it out because it doesn't know. The human energy field has seven prime vortexes which connect us with wider reality (Fig 23). Chakra means

'wheels of light' in the Sanskrit language of ancient India. The main ones are: The crown chakra on top of the head; brow (or 'third eye') chakra in the centre of the forehead; throat chakra; heart chakra in the centre of the chest; solar plexus chakra below the sternum; sacral chakra beneath the navel; and base chakra at the bottom of the spine. Each one has a particular function or functions. We feel anxiety and nervousness in the belly where the sacral chakra is located and this processes emotion that can affect the colon to give people 'the shits' or make them 'shit scared' when they are nervous. Chakras all play an important role, but the Mr and Mrs Big is the heart chakra which sits at the centre of the seven, above the chakras that connect us to the 'physical' and below those that connect with higher realms (or at least should). Here in the heart chakra we feel love, empathy and compassion – 'My heart goes out to you'. Those with closed hearts become literally 'heart-less' in their attitudes and behaviour (see Bill Gates). Native Americans portrayed Wetiko with what Paul Levy calls a 'frigid, icy heart, devoid of mercy' (see Bill Gates).

Figure 23: The chakra system which interpenetrates the human energy field. The heart chakra is the governor – or should be.

Wetiko trembles at the thought of heart energy which it cannot infiltrate. The frequency is too high. What it seeks to do instead is close the heart chakra vortex to block its perceptual and energetic influence. Psychopaths have 'hearts of stone' and emotionally-damaged people have 'heartache' and 'broken hearts'. The astonishing amount of heart disease is related to heart chakra

disruption with its fundamental connection to the 'physical' heart. Dr Tom Cowan has written an outstanding book challenging the belief that the heart is a pump and making the connection between the 'physical' and spiritual heart. Rudolph Steiner who was way ahead of his time said the same about the fallacy that the heart is a pump. *What*? The heart is not a pump? That's crazy, right? Everybody knows that. Read Cowan's *Human Heart, Cosmic Heart* and you will realise that the very idea of the heart as a pump is ridiculous when you see the evidence. How does blood in the feet so far from the heart get pumped horizontally up the body by the heart?? Cowan explains in the book the real reason why blood moves as it does. Our 'physical' heart is used to symbolise love when the source is really the heart vortex or spiritual heart which is our most powerful energetic connection to 'out there' expanded consciousness. That's why we feel *knowing* – intuitive knowing – in the centre of the chest. Knowing doesn't come from a process of thoughts leading to a conclusion. It is there in an instant all in one go. Our heart knows because of its connection to levels of awareness that *do* know. This is the meaning and source of intuition – intuitive *knowing*.

For the last more than 30 years of uncovering the global game and the nature of reality my heart has been my constant antenna for truth and accuracy. An American intelligence insider once said that I had quoted a disinformer in one of my books and yet I had only quoted the part that was true. He asked: 'How do you do that?' By using my heart antenna was the answer and anyone can do it. Heart-centred is how we are meant to be. With a closed heart chakra we withdraw into a closed mind and the bubble of five-sense reality. If you take a moment to focus your attention on the centre of your chest, picture a spinning wheel of light and see it opening and expanding. You will feel it happening, too, and perceptions of the heart like joy and love as the heart impacts on the mind as they interact. The more the chakra opens the more you will feel expressions of heart consciousness and as the process continues, and becomes part of you, insights and knowings will follow. An open

heart is connected to that level of awareness that knows all is *One*. You will see from its perspective that the fault-lines that divide us are only illusions to control us. An open heart does not process the illusions of race, creed and sexuality except as brief experiences for a consciousness that is all. Our heart does not see division, only unity (Figs 24 and 25). There's something else, too. Our hearts love to laugh. Mark Twain's quote that says 'The human race has one really effective weapon, and that is laughter' is really a reference to the heart which loves to laugh with the joy of knowing the true nature of infinite reality and that all the madness of human society is an illusion of the mind. Twain also said: 'Against the assault of laughter nothing can stand.' This is so true of Wetiko and the Cult. Their insecurity demands that they be taken seriously and their power and authority acknowledged and feared. We should do nothing of the sort. We should not get aggressive or fearful which their insecurity so desires. We should laugh in their face. Even in their no-face as police come over in their face-nappies and expect to be taken seriously. They don't take themselves seriously looking like that so why should we? Laugh in the face of intimidation. Laugh in the face of tyranny. You will see by its reaction that you have pressed all of its buttons. Wetiko does not know what to do in the face of laughter or when its targets refuse to concede their joy to fear. We have seen many examples during the 'Covid' hoax when people have expressed their energetic power and the string puppets of Wetiko retreat with their tail limp between their knees. Laugh – the world is bloody mad after all and if it's a choice between laughter and tears I know which way I'm going.

Figure 24: Head consciousness without the heart sees division and everything apart from everything else.

Figure 25: Heart consciousness sees everything as One.

'Vaccines' and the soul

The foundation of Wetiko/Archon control of humans is the separation of incarnate five-sense mind from the infinite 'I' and closing the heart chakra where the True 'I' lives during a human life. The goal has been to achieve complete separation in both cases. I was interested therefore to read an account by a French energetic healer of what she said she experienced with a patient who had been given the 'Covid' vaccine. Genuine energy healers can sense information and consciousness fields at different levels of being which are referred to as 'subtle bodies'. She described treating the patient who later returned after having, without the healer's knowledge, two doses of the 'Covid vaccine'. The healer said:

I noticed immediately the change, very heavy energy emanating from [the] subtle bodies. The scariest thing was when I was working on the heart chakra, I connected with her soul: it was detached from the physical body, it had no contact and it was, as if it was floating in a state of total confusion: a damage to the consciousness that loses contact with the physical body, i.e. with our biological machine, there is no longer any communication between them.

I continued the treatment by sending light to the heart chakra, the soul of the person, but it seemed that the soul could no longer receive any light, frequency or energy. It was a very powerful experience for me. Then I understood that this substance is indeed used to detach consciousness so that this consciousness can no longer interact through this body that it possesses in life, where there is no longer any contact, no frequency, no light, no more energetic balance or mind.

This would create a human that is rudderless and at the extreme almost zombie-like operating with a fractional state of consciousness at the mercy of Wetiko. I was especially intrigued by what the healer said in the light of the prediction by the highly-informed Rudolf Steiner more than a hundred years ago. He said:

In the future, we will eliminate the soul with medicine. Under the pretext of a 'healthy point of view', there will be a vaccine by which the human body will be treated as soon as possible directly at birth, so that the human being cannot develop the thought of the existence of soul and Spirit. To materialistic doctors will be entrusted the task of removing the soul of humanity.

As today, people are vaccinated against this disease or that disease, so in the future, children will be vaccinated with a substance that can be produced precisely in such a way that people, thanks to this vaccination, will be immune to being subjected to the 'madness' of spiritual life. He would be extremely smart, but he would not develop a conscience, and that is the true goal of some materialistic circles.

Steiner said the vaccine would detach the physical body from the etheric body (subtle bodies) and 'once the etheric body is detached the relationship between the universe and the etheric body would become extremely unstable, and man would become an automaton'. He said 'the physical body of man must be polished on this Earth by spiritual will – so the vaccine becomes a kind of arymanique (Wetiko) force' and 'man can no longer get rid of a given materialistic feeling'. Humans would then, he said, become 'materialistic of constitution and can no longer rise to the spiritual'. I have been writing for years about DNA being a receiver-transmitter of information that connects us to other levels of reality and these 'vaccines' changing DNA can be likened to changing an antenna and what it can transmit and receive. Such a disconnection would clearly lead to changes in personality and perception. Steiner further predicted the arrival of AI. Big Pharma 'Covid vaccine' makers, expressions of Wetiko, are testing their DNA-manipulating evil on children as I write with a view to giving the 'vaccine' to babies. If it's a soul-body disconnector – and I say that it is or can be – every child would be disconnected from 'soul' at birth and the 'vaccine' would create a closed system in which spiritual guidance from the greater self would play no part. This has been the ambition of Wetiko all

along. A Pentagon video from 2005 was leaked of a presentation explaining the development of vaccines to change behaviour by their effect on the brain. Those that believe this is not happening with the 'Covid' genetically-modifying procedure masquerading as a 'vaccine' should make an urgent appointment with Naivety Anonymous. Klaus Schwab wrote in 2018:

> Neurotechnologies enable us to better influence consciousness and thought and to understand many activities of the brain. They include decoding what we are thinking in fine levels of detail through new chemicals and interventions that can influence our brains to correct for errors or enhance functionality.

The plan is clear and only the heart can stop it. With every heart that opens, every mind that awakens, Wetiko is weakened. Heart and love are far more powerful than head and hate and so nothing like a majority is needed to turn this around.

Beyond the Phantom

Our heart is the prime target of Wetiko and so it must be the answer to Wetiko. We *are* our heart which is part of one heart, the infinite heart. Our heart is where the true self lives in a human life behind firewalls of five-sense illusion when an imposter takes its place – *Phantom Self*; but our heart waits patiently to be set free any time we choose to see beyond the Phantom, beyond Wetiko. A Wetikoed Phantom Self can wreak mass death and destruction while the love of forever is locked away in its heart. The time is here to unleash its power and let it sweep away the fear and despair that is Wetiko. Heart consciousness does not seek manipulated, censored, advantage for its belief or religion, its activism and desires. As an expression of the One it treats all as One with the same rights to freedom and opinion. Our heart demands fairness for itself no more than for others. From this unity of heart we can come together in mutual support and transform this Wetikoed world into what reality is meant to be – a place of love, joy, happiness, fairness, justice and freedom. Wetiko has another agenda and that's why the world is as

it is, but enough of this nonsense. Wetiko can't stay where hearts are open and it works so hard to keep them closed. Fear is its currency and its food source and love in its true sense has no fear. Why would love have fear when it knows it is *All That Is, Has Been, And Ever Can Be* on an eternal exploration of all possibility? Love in this true sense is not the physical attraction that passes for love. This can be an expression of it, yes, but Infinite Love, a love without condition, goes far deeper to the core of all being. It *is* the core of all being. Infinite realty was born from love beyond the illusions of the simulation. Love infinitely expressed is the knowing that all is One and the swiftly-passing experience of separation is a temporary hallucination. You cannot disconnect from Oneness; you can only *perceive* that you have and withdraw from its influence. This is the most important of all perception trickery by the mind parasite that is Wetiko and the foundation of all its potential for manipulation.

If we open our hearts, open the sluice gates of the mind, and redefine self-identity amazing things start to happen. Consciousness expands or contracts in accordance with self-identity. When true self is recognised as infinite awareness and label self – Phantom Self – is seen as only a series of brief experiences life is transformed. Consciousness expands to the extent that self-identity expands and everything changes. You see unity, not division, the picture, not the pixels. From this we can play the long game. No more is an experience something in and of itself, but a fleeting moment in the eternity of forever. Suddenly people in uniform and dark suits are no longer intimidating. Doing what your heart knows to be right is no longer intimidating and consequences for those actions take on the same nature of a brief experience that passes in the blink of an infinite eye. Intimidation is all in the mind. Beyond the mind there is no intimidation.

An open heart does not consider consequences for what it knows to be right. To do so would be to consider not doing what it knows to be right and for a heart in its power that is never an option. The Renegade Mind is really the Renegade Heart. Consideration of consequences will always provide a getaway car for the mind and

the heart doesn't want one. What is right in the light of what we face today is to stop cooperating with Wetiko in all its forms and to do it without fear or compromise. You cannot compromise with tyranny when tyranny always demands more until it has everything. Life is your perception and you are your destiny. Change your perception and you change your life. Change collective perception and we change the world.

Come on people … One human family, One heart, One goal … *FREEEEEEDOM*!

We must settle for nothing less.

Postscript

The big scare story as the book goes to press is the 'Indian' variant and the world is being deluged with propaganda about the 'Covid catastrophe' in India which mirrors in its lies and misrepresentations what happened in Italy before the first lockdown in 2020.

The *New York Post* published a picture of someone who had 'collapsed in the street from Covid' in India in April, 2021, which was actually taken during a gas leak in May, 2020. Same old, same old. Media articles in mid-February were asking why India had been so untouched by 'Covid' and then as their vaccine rollout gathered pace the alleged 'cases' began to rapidly increase. Indian 'Covid vaccine' maker Bharat Biotech was funded into existence by the Bill and Melinda Gates Foundation (the pair announced their divorce in May, 2021, which is a pity because they so deserve each other). The Indian 'Covid crisis' was ramped up by the media to terrify the world and prepare people for submission to still more restrictions. The scam that worked the first time was being repeated only with far more people seeing through the deceit. Davidicke.com and Ickonic.com have sought to tell the true story of what is happening by talking to people living through the Indian nightmare which has nothing to do with 'Covid'. We posted a letter from 'Alisha' in Pune who told a very different story to government and media mendacity. She said scenes of dying people and overwhelmed hospitals were designed to hide what was really happening – genocide and starvation. Alisha said that millions had already died of starvation during the ongoing lockdowns while government and media were lying and making it look like the 'virus':

Restaurants, shops, gyms, theatres, basically everything is shut. The cities are ghost towns. Even so-called 'essential' businesses are only open till 11am in the morning. You basically have just an hour to buy food and then your time is up.

Inter-state travel and even inter-district travel is banned. The cops wait at all major crossroads to question why you are traveling outdoors or to fine you if you are not wearing a mask.

The medical community here is also complicit in genocide, lying about hospitals being full and turning away people with genuine illnesses, who need immediate care. They have even created a shortage of oxygen cylinders.

This is the classic Cult modus operandi played out in every country. Alisha said that people who would not have a PCR test not testing for the 'virus' were being denied hospital treatment. She said the people hit hardest were migrant workers and those in rural areas. Most businesses employed migrant workers and with everything closed there were no jobs, no income and no food. As a result millions were dying of starvation or malnutrition. All this was happening under Prime Minister Narendra Modi, a 100-percent asset of the Cult, and it emphasises yet again the scale of pure anti-human evil we are dealing with. Australia banned its people from returning home from India with penalties for trying to do so of up to five years in jail and a fine of £37,000. The manufactured 'Covid' crisis in India was being prepared to justify further fascism in the West. Obvious connections could be seen between the Indian 'vaccine' programme and increased 'cases' and this became a common theme. The Seychelles, the most per capita 'Covid vaccinated' population in the world, went back into lockdown after a 'surge of cases'.

Long ago the truly evil Monsanto agricultural biotechnology corporation with its big connections to Bill Gates devastated Indian farming with genetically-modified crops. Human rights activist Gurcharan Singh highlighted the efforts by the Indian government to complete the job by destroying the food supply to hundreds of millions with 'Covid' lockdowns. He said that 415 million people at the bottom of the disgusting caste system (still going whatever they say) were below the poverty line and struggled to feed themselves every year. Now the government was imposing lockdown at just the

time to destroy the harvest. This deliberate policy was leading to mass starvation. People may reel back at the suggestion that a government would do that, but Wetiko-controlled 'leaders' are capable of any level of evil. In fact what is described in India is in the process of being instigated worldwide. The food chain and food supply are being targeted at every level to cause world hunger and thus control. Bill Gates is not the biggest owner of farmland in America for no reason and destroying access to food aids both the depopulation agenda and the plan for synthetic 'food' already being funded into existence by Gates. Add to this the coming hyper-inflation from the suicidal creation of fake 'money' in response to 'Covid' and the breakdown of container shipping systems and you have a cocktail that can only lead one way and is meant to. The Cult plan is to crash the entire system to 'build back better' with the Great Reset.

'Vaccine' transmission

Reports from all over the world continue to emerge of women suffering menstrual and fertility problems after having the fake 'vaccine' and of the non-'vaccinated' having similar problems when interacting with the 'vaccinated'. There are far too many for 'coincidence' to be credible. We've had menopausal women getting periods, others having periods stop or not stopping for weeks, passing clots, sometimes the lining of the uterus, breast irregularities, and miscarriages (which increased by 400 percent in parts of the United States). Non-'vaccinated' men and children have suffered blood clots and nose bleeding after interaction with the 'vaccinated'. Babies have died from the effects of breast milk from a 'vaccinated' mother. Awake doctors – the small minority – speculated on the cause of non-'vaccinated' suffering the same effects as the 'vaccinated'. Was it nanotechnology in the synthetic substance transmitting frequencies or was it a straight chemical bioweapon that was being transmitted between people? I am not saying that some kind of chemical transmission is not one possible answer, but the foundation of all that the Cult does is frequency and

this is fertile ground for understanding how transmission can happen. American doctor Carrie Madej, an internal medicine physician and osteopath, has been practicing for the last 20 years, teaching medical students, and she says attending different meetings where the agenda for humanity was discussed. Madej, who operates out of Georgia, did not dismiss other possible forms of transmission, but she focused on frequency in search of an explanation for transmission. She said the Moderna and Pfizer 'vaccines' contained nano-lipid particles as a key component. This was a brand new technology never before used on humanity. 'They're using a nanotechnology which is pretty much little tiny computer bits … nanobots or hydrogel.' Inside the 'vaccines' was 'this sci-fi kind of substance' which suppressed immune checkpoints to get into the cell. I referred to this earlier as the 'Trojan horse' technique that tricks the cell into opening a gateway for the self-replicating synthetic material and while the immune system is artificially suppressed the body has no defences. Madej said the substance served many purposes including an on-demand ability to 'deliver the payload' and using the nano 'computer bits' as biosensors in the body. 'It actually has the ability to accumulate data from your body, like your breathing, your respiration, thoughts, emotions, all kinds of things.'

She said the technology obviously has the ability to operate through Wi-Fi and transmit and receive energy, messages, frequencies or impulses. 'Just imagine you're getting this new substance in you and it can react to things all around you, the 5G, your smart device, your phones.' We had something completely foreign in the human body that had never been launched large scale at a time when we were seeing 5G going into schools and hospitals (plus the Musk satellites) and she believed the 'vaccine' transmission had something to do with this: '… if these people have this inside of them … it can act like an antenna and actually transmit it outwardly as well.' The synthetic substance produced its own voltage and so it could have that kind of effect. This fits with my own contention that the nano receiver-transmitters are designed to connect people to the

Smart Grid and break the receiver-transmitter connection to expanded consciousness. That would explain the French energy healer's experience of the disconnection of body from 'soul' with those who have had the 'vaccine'. The nanobots, self-replicating inside the body, would also transmit the synthetic frequency which could be picked up through close interaction by those who have not been 'vaccinated'. Madej speculated that perhaps it was 5G and increased levels of other radiation that was causing the symptoms directly although interestingly she said that non-'vaccinated' patients had shown improvement when they were away from the 'vaccinated' person they had interacted with. It must be remembered that you can control frequency and energy with your mind and you can consciously create energetic barriers or bubbles with the mind to stop damaging frequencies from penetrating your field. American paediatrician Dr Larry Palevsky said the 'vaccine' was not a 'vaccine' and was never designed to protect from a 'viral' infection. He called it 'a massive, brilliant propaganda of genocide' because they didn't have to inject everyone to get the result they wanted. He said the content of the jabs was able to infuse any material into the brain, heart, lungs, kidneys, liver, sperm and female productive system. 'This is genocide; this is a weapon of mass destruction.' At the same time American colleges were banning students from attending if they didn't have this life-changing and potentially life-ending 'vaccine'. Class action lawsuits must follow when the consequences of this college fascism come to light. As the book was going to press came reports about fertility effects on sperm in 'vaccinated' men which would absolutely fit with what I have been saying and hospitals continued to fill with 'vaccine' reactions. Another question is what about transmission via blood transfusions? The NHS has extended blood donation restrictions from seven days after a 'Covid vaccination' to 28 days after even a sore arm reaction.

I said in the spring of 2020 that the then touted 'Covid vaccine' would be ongoing each year like the flu jab. A year later Pfizer CEO, the appalling Albert Bourla, said people would 'likely' need a 'booster dose' of the 'vaccine' within 12 months of getting 'fully

vaccinated' and then a yearly shot. 'Variants will play a key role', he said confirming the point. Johnson & Johnson CEO Alex Gorsky also took time out from his 'vaccine' disaster to say that people may need to be vaccinated against 'Covid-19' each year. UK Health Secretary, the psychopath Matt Hancock, said additional 'boosters' would be available in the autumn of 2021. This is the trap of the 'vaccine passport'. The public will have to accept every last 'vaccine' they introduce, including for the fake 'variants', or it would cease to be valid. The only other way in some cases would be continuous testing with a test not testing for the 'virus' and what is on the swabs constantly pushed up your noise towards the brain every time?

'Vaccines' changing behaviour

I mentioned in the body of the book how I believed we would see gathering behaviour changes in the 'vaccinated' and I am already hearing such comments from the non-'vaccinated' describing behaviour changes in friends, loved ones and work colleagues. This will only increase as the self-replicating synthetic material and nanoparticles expand in body and brain. An article in the *Guardian* in 2016 detailed research at the University of Virginia in Charlottesville which developed a new method for controlling brain circuits associated with complex animal behaviour. The method, dubbed 'magnetogenetics', involves genetically-engineering a protein called ferritin, which stores and releases iron, to create a magnetised substance – 'Magneto' – that can activate specific groups of nerve cells from a distance. This is claimed to be an advance on other methods of brain activity manipulation known as optogenetics and chemogenetics (the Cult has been developing methods of brain control for a long time). The ferritin technique is said to be non-invasive and able to activate neurons 'rapidly and reversibly'. In other words, human thought and perception. The article said that earlier studies revealed how nerve cell proteins 'activated by heat and mechanical pressure can be genetically engineered so that they become sensitive to radio waves and magnetic fields, by attaching them to an iron-storing protein called ferritin, or to inorganic

paramagnetic particles'. Sensitive to radio waves and magnetic fields? You mean like 5G, 6G and 7G? This is the human-AI Smart Grid hive mind we are talking about. The *Guardian* article said:

> … the researchers injected Magneto into the striatum of freely behaving mice, a deep brain structure containing dopamine-producing neurons that are involved in reward and motivation, and then placed the animals into an apparatus split into magnetised and non-magnetised sections.
>
> Mice expressing Magneto spent far more time in the magnetised areas than mice that did not, because activation of the protein caused the striatal neurons expressing it to release dopamine, so that the mice found being in those areas rewarding. This shows that Magneto can remotely control the firing of neurons deep within the brain, and also control complex behaviours.

Make no mistake this basic methodology will be part of the 'Covid vaccine' cocktail and using magnetics to change brain function through electromagnetic field frequency activation. The Pentagon is developing a 'Covid vaccine' using ferritin. Magnetics would explain changes in behaviour and why videos are appearing across the Internet as I write showing how magnets stick to the skin at the point of the 'vaccine' shot. Once people take these 'vaccines' anything becomes possible in terms of brain function and illness which will be blamed on 'Covid-19' and 'variants'. Magnetic field manipulation would further explain why the non-'vaccinated' are reporting the same symptoms as the 'vaccinated' they interact with and why those symptoms are reported to decrease when not in their company. Interestingly 'Magneto', a 'mutant', is a character in the Marvel Comic *X-Men* stories with the ability to manipulate magnetic fields and he believes that mutants should fight back against their human oppressors by any means necessary. The character was born Erik Lehnsherr to a Jewish family in Germany.

Cult-controlled courts

The European Court of Human Rights opened the door for mandatory 'Covid-19 vaccines' across the continent when it ruled in a Czech Republic dispute over childhood immunisation that legally

enforced vaccination could be 'necessary in a democratic society'. The 17 judges decided that compulsory vaccinations did not breach human rights law. On the face of it the judgement was so inverted you gasp for air. If not having a vaccine infused into your body is not a human right then what is? Ah, but they said human rights law which has been specifically written to delete all human rights at the behest of the state (the Cult). Article 8 of the European Convention on Human Rights relates to the right to a private life. The crucial word here is *'except'*:

> There shall be no interference by a public authority with the exercise of this right EXCEPT such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic wellbeing of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others [My emphasis].

No interference *except* in accordance with the law means there *are* no 'human rights' *except* what EU governments decide you can have at their behest. 'As is necessary in a democratic society' explains that reference in the judgement and 'in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others' gives the EU a coach and horses to ride through 'human rights' and scatter them in all directions. The judiciary is not a check and balance on government extremism; it is a vehicle to enforce it. This judgement was almost laughably predictable when the last thing the Cult wanted was a decision that went against mandatory vaccination. Judges rule over and over again to benefit the system of which they are a part. Vaccination disputes that come before them are invariably delivered in favour of doctors and authorities representing the view of the state which owns the judiciary. Oh, yes, and we have even had calls to stop putting 'Covid-19' on death certificates within 28 days of a 'positive test' because it is claimed the practice makes the 'vaccine' appear not to work. They are laughing at you.

The scale of madness, inhumanity and things to come was highlighted when those not 'vaccinated' for 'Covid' were refused evacuation from the Caribbean island of St Vincent during massive volcanic eruptions. Cruise ships taking residents to the safety of another island allowed only the 'vaccinated' to board and the rest were left to their fate. Even in life and death situations like this we see 'Covid' stripping people of their most basic human instincts and the insanity is even more extreme when you think that fake 'vaccine'-makers are not even claiming their body-manipulating concoctions stop 'infection' and 'transmission' of a 'virus' that doesn't exist. St Vincent Prime Minister Ralph Gonsalves said: 'The chief medical officer will be identifying the persons already vaccinated so that we can get them on the ship.' Note again the power of the chief medical officer who, like Whitty in the UK, will be answering to the World Health Organization. This is the Cult network structure that has overridden politicians who 'follow the science' which means doing what WHO-controlled 'medical officers' and 'science advisers' tell them. Gonsalves even said that residents who were 'vaccinated' after the order so they could board the ships would still be refused entry due to possible side effects such as 'wooziness in the head'. The good news is that if they were woozy enough in the head they could qualify to be prime minister of St Vincent.

Microchipping freedom

The European judgement will be used at some point to justify moves to enforce the 'Covid' DNA-manipulating procedure. Sandra Ro, CEO of the Global Blockchain Business Council, told a World Economic Forum event that she hoped 'vaccine passports' would help to 'drive forced consent and standardisation' of global digital identity schemes: 'I'm hoping with the desire and global demand for some sort of vaccine passport – so that people can get travelling and working again – [it] will drive forced consent, standardisation, and frankly, cooperation across the world.' The lady is either not very bright, or thoroughly mendacious, to use the term 'forced consent'.

You do not 'consent' if you are forced – you *submit*. She was describing what the plan has been all along and that's to enforce a digital identity on every human without which they could not function. 'Vaccine passports' are opening the door and are far from the end goal. A digital identity would allow you to be tracked in everything you do in cyberspace and this is the same technique used by Cult-owned China to enforce its social credit system of total control. The ultimate 'passport' is planned to be a microchip as my books have warned for nearly 30 years. Those nice people at the Pentagon working for the Cult-controlled Defense Advanced Research Projects Agency (DARPA) claimed in April, 2021, they have developed a microchip inserted under the skin to detect 'asymptomatic Covid-19 infection' before it becomes an outbreak and a 'revolutionary filter' that can remove the 'virus' from the blood when attached to a dialysis machine. The only problems with this are that the 'virus' does not exist and people transmitting the 'virus' with no symptoms is brain-numbing bullshit. This is, of course, not a ruse to get people to be microchipped for very different reasons. DARPA also said it was producing a one-stop 'vaccine' for the 'virus' and all 'variants'. One of the most sinister organisations on Planet Earth is doing this? Better have it then. These people are insane because Wetiko that possesses them is insane.

Researchers from the Salk Institute in California announced they have created an embryo that is part human and part monkey. My books going back to the 1990s have exposed experiments in top secret underground facilities in the United States where humans are being crossed with animal and non-human 'extraterrestrial' species. They are now easing that long-developed capability into the public arena and there is much more to come given we are dealing with psychiatric basket cases. Talking of which – Elon Musk's scientists at Neuralink trained a monkey to play Pong and other puzzles on a computer screen using a joystick and when the monkey made the correct move a metal tube squirted banana smoothie into his mouth which is the basic technique for training humans into unquestioning compliance. Two Neuralink chips were in the monkey's skull and

more than 2,000 wires 'fanned out' into its brain. Eventually the monkey played a video game purely with its brain waves. Psychopathic narcissist Musk said the 'breakthrough' was a step towards putting Neuralink chips into human skulls and merging minds with artificial intelligence. *Exactly*. This man is so dark and Cult to his DNA.

World Economic Fascism (WEF)

The World Economic Forum is telling you the plan by the statements made at its many and various events. Cult-owned fascist YouTube CEO Susan Wojcicki spoke at the 2021 WEF Global Technology Governance Summit (see the name) in which 40 governments and 150 companies met to ensure 'the responsible design and deployment of emerging technologies'. Orwellian translation: 'Ensuring the design and deployment of long-planned technologies will advance the Cult agenda for control and censorship.' Freedom-destroyer and Nuremberg-bound Wojcicki expressed support for tech platforms like hers to censor content that is 'technically legal but could be harmful'. Who decides what is 'harmful'? She does and they do. 'Harmful' will be whatever the Cult doesn't want people to see and we have legislation proposed by the UK government that would censor content on the basis of 'harm' no matter if the information is fair, legal and provably true. Make that *especially* if it is fair, legal and provably true. Wojcicki called for a global coalition to be formed to enforce content moderation standards through automated censorship. This is a woman and mega-censor so self-deluded that she shamelessly accepted a 'free expression' award – *Wojcicki* – in an event sponsored by her own *YouTube*. They have no shame and no self-awareness.

You know that 'Covid' is a scam and Wojcicki a Cult operative when YouTube is censoring medical and scientific opinion purely on the grounds of whether it supports or opposes the Cult 'Covid' narrative. Florida governor Ron DeSantis compiled an expert panel with four professors of medicine from Harvard, Oxford, and Stanford Universities who spoke against forcing children and

vaccinated people to wear masks. They also said there was no proof that lockdowns reduced spread or death rates of 'Covid-19'. Cult-gofer Wojcicki and her YouTube deleted the panel video 'because it included content that contradicts the consensus of local and global health authorities regarding the efficacy of masks to prevent the spread of Covid-19'. This 'consensus' refers to what the Cult tells the World Health Organization to say and the WHO tells 'local health authorities' to do. Wojcicki knows this, of course. The panellists pointed out that censorship of scientific debate was responsible for deaths from many causes, but Wojcicki couldn't care less. She would not dare go against what she is told and as a disgrace to humanity she wouldn't want to anyway. The UK government is seeking to pass a fascist 'Online Safety Bill' to specifically target with massive fines and other means non-censored video and social media platforms to make them censor 'lawful but harmful' content like the Cult-owned Facebook, Twitter, Google and YouTube. What is 'lawful but harmful' would be decided by the fascist Blair-created Ofcom.

Another WEF obsession is a cyber-attack on the financial system and this is clearly what the Cult has planned to take down the bank accounts of everyone – except theirs. Those that think they have enough money for the Cult agenda not to matter to them have got a big lesson coming if they continue to ignore what is staring them in the face. The World Economic Forum, funded by Gates and fronted by Klaus Schwab, announced it would be running a 'simulation' with the Russian government and global banks of just such an attack called Cyber Polygon 2021. What they simulate – as with the 'Covid' Event 201 – they plan to instigate. The WEF is involved in a project with the Cult-owned Carnegie Endowment for International Peace called the WEF-Carnegie Cyber Policy Initiative which seeks to merge Wall Street banks, 'regulators' (I love it) and intelligence agencies to 'prevent' (arrange and allow) a cyber-attack that would bring down the global financial system as long planned by those that control the WEF and the Carnegie operation. The Carnegie Endowment for International Peace sent an instruction to First World

War US President Woodrow Wilson not to let the war end before society had been irreversibly transformed.

The Wuhan lab diversion

As I close, the Cult-controlled authorities and lapdog media are systematically pushing 'the virus was released from the Wuhan lab' narrative. There are two versions – it happened by accident and it happened on purpose. Both are nonsense. The perceived existence of the never-shown-to-exist 'virus' is vital to sell the impression that there is actually an infective agent to deal with and to allow the endless potential for terrifying the population with 'variants' of a 'virus' that does not exist. The authorities at the time of writing are going with the 'by accident' while the alternative media is promoting the 'on purpose'. Cable news host Tucker Carlson who has questioned aspects of lockdown and 'vaccine' compulsion has bought the Wuhan lab story. 'Everyone now agrees' he said. Well, I don't and many others don't and the question is *why* does the system and its media suddenly 'agree'? When the media moves as one unit with a narrative it is always a lie – witness the hour by hour mendacity of the 'Covid' era. Why would this Cult-owned combination which has unleashed lies like machine gun fire suddenly 'agree' to tell the truth??

Much of the alternative media is buying the lie because it fits the conspiracy narrative, but it's the *wrong* conspiracy. The real conspiracy is that *there is no virus* and that is what the Cult is desperate to hide. The idea that the 'virus' was released by accident is ludicrous when the whole 'Covid' hoax was clearly long-planned and waiting to be played out as it was so fast in accordance with the Rockefeller document and Event 201. So they prepared everything in detail over decades and then sat around strumming their fingers waiting for an 'accidental' release from a bio-lab? *What??* It's crazy. Then there's the 'on purpose' claim. You want to circulate a 'deadly virus' and hide the fact that you've done so and you release it down the street from the highest-level bio-lab in China? I repeat – *What??*

You would release it far from that lab to stop any association being made. But, no, we'll do it in a place where the connection was certain to be made. Why would you need to scam 'cases' and 'deaths' and pay hospitals to diagnose 'Covid-19' if you had a real 'virus'? What are sections of the alternative media doing believing this crap? Where were all the mass deaths in Wuhan from a 'deadly pathogen' when the recovery to normal life after the initial propaganda was dramatic in speed? Why isn't the 'deadly pathogen' now circulating all over China with bodies in the street? Once again we have the technique of tell them what they want to hear and they will likely believe it. The alternative media has its 'conspiracy' and with Carlson it fits with his 'China is the danger' narrative over years. China *is* a danger as a global Cult operations centre, but not for this reason. The Wuhan lab story also has the potential to instigate conflict with China when at some stage the plan is to trigger a Problem-Reaction-Solution confrontation with the West. Question everything – *everything* – and especially when the media agrees on a common party line.

Third wave ... fourth wave ... fifth wave ...

As the book went into production the world was being set up for more lockdowns and a 'third wave' supported by invented 'variants' that were increasing all the time and will continue to do so in public statements and computer programs, but not in reality. India became the new Italy in the 'Covid' propaganda campaign and we were told to be frightened of the new 'Indian strain'. Somehow I couldn't find it within myself to do so. A document produced for the UK government entitled 'Summary of further modelling of easing of restrictions – Roadmap Step 2' declared that a third wave was inevitable (of course when it's in the script) and it would be the fault of children and those who refuse the health-destroying fake 'Covid vaccine'. One of the computer models involved came from the Cult-owned *Imperial College* and the other from Warwick University which I wouldn't trust to tell me the date in a calendar factory. The document states that both models presumed extremely high uptake

of the 'Covid vaccines' and didn't allow for 'variants'. The document states: 'The resurgence is a result of some people (mostly children) being ineligible for vaccination; others choosing not to receive the vaccine; and others being vaccinated but not perfectly protected.' The mendacity takes the breath away. Okay, blame those with a brain who won't take the DNA-modifying shots and put more pressure on children to have it as 'trials' were underway involving children as young as six months with parents who give insanity a bad name. Massive pressure is being put on the young to have the fake 'vaccine' and child age consent limits have been systematically lowered around the world to stop parents intervening. Most extraordinary about the document was its claim that the 'third wave' would be driven by 'the resurgence in both hospitalisations and deaths … dominated by *those that have received two doses of the vaccine*, comprising around 60-70% of the wave respectively'. The predicted peak of the 'third wave' suggested 300 deaths per day with 250 of them *fully 'vaccinated' people*. How many more lies do acquiescers need to be told before they see the obvious? Those who took the jab to 'protect themselves' are projected to be those who mostly get sick and die? So what's in the 'vaccine'? The document went on:

> It is possible that a summer of low prevalence could be followed by substantial increases in incidence over the following autumn and winter. Low prevalence in late summer should not be taken as an indication that SARS-CoV-2 has retreated or that the population has high enough levels of immunity to prevent another wave.

They are telling you the script and while many British people believed 'Covid' restrictions would end in the summer of 2021 the government was preparing for them to be ongoing. Authorities were awarding contracts for 'Covid marshals' to police the restrictions with contracts starting in July, 2021, and going through to January 31st, 2022, and the government was advertising for 'Media Buying Services' to secure media propaganda slots worth a potential £320 million for 'Covid-19 campaigns' with a contract not ending until March, 2022. The recipient – via a list of other front companies – was reported to be American media marketing giant Omnicom Group

Inc. While money is no object for 'Covid' the UK waiting list for all other treatment – including life-threatening conditions – passed 4.5 million. Meantime the Cult is seeking to control all official 'inquiries' to block revelations about what has really been happening and why. It must not be allowed to – we need Nuremberg jury trials in every country. The cover-up doesn't get more obvious than appointing ultra-Zionist professor Philip Zelikow to oversee two dozen US virologists, public health officials, clinicians, former government officials and four American 'charitable foundations' to 'learn the lessons' of the 'Covid' debacle. The personnel will be those that created and perpetuated the 'Covid' lies while Zelikow is the former executive director of the 9/11 Commission who ensured that the truth about those attacks never came out and produced a report that must be among the most mendacious and manipulative documents ever written – see *The Trigger* for the detailed exposure of the almost unimaginable 9/11 story in which Sabbatians can be found at every level.

Passive no more

People are increasingly challenging the authorities with amazing numbers of people taking to the streets in London well beyond the ability of the Face-Nappies to stop them. Instead the Nappies choose situations away from the mass crowds to target, intimidate, and seek to promote the impression of 'violent protestors'. One such incident happened in London's Hyde Park. Hundreds of thousands walking through the streets in protest against 'Covid' fascism were ignored by the Cult-owned BBC and most of the rest of the mainstream media, but they delighted in reporting how police were injured in 'clashes with protestors'. The truth was that a group of people gathered in Hyde Park at the end of one march when most had gone home and they were peacefully having a good time with music and chat. Face-Nappies who couldn't deal with the full-march crowd then waded in with their batons and got more than they bargained for. Instead of just standing for this criminal brutality the crowd used their numerical superiority to push the Face-Nappies out of the

park. Eventually the Nappies turned and ran. Unfortunately two or three idiots in the crowd threw drink cans striking two officers which gave the media and the government the image they wanted to discredit the 99.9999 percent who were peaceful. The idiots walked straight into the trap and we must always be aware of potential agent provocateurs used by the authorities to discredit their targets.

This response from the crowd – the can people apart – must be a turning point when the public no longer stand by while the innocent are arrested and brutally attacked by the Face-Nappies. That doesn't mean to be violent, that's the last thing we need. We'll leave the violence to the Face-Nappies and government. But it does mean that when the Face-Nappies use violence against peaceful people the numerical superiority is employed to stop them and make citizen's arrests or Common Law arrests for a breach of the peace. The time for being passive in the face of fascism is over.

We are the many, they are the few, and we need to make that count before there is no freedom left and our children and grandchildren face an ongoing fascist nightmare.

COME ON PEOPLE – IT'S TIME.

One final thought …

The power of love
A force from above
Cleaning my soul
Flame on burn desire
Love with tongues of fire
Purge the soul
Make love your goal

I'll protect you from the hooded claw
Keep the vampires from your door
When the chips are down I'll be around
With my undying, death-defying
Love for you

Envy will hurt itself
Let yourself be beautiful
Sparkling love, flowers
And pearls and pretty girls
Love is like an energy
Rushin' rushin' inside of me

This time we go sublime
Lovers entwine, divine, divine,
Love is danger, love is pleasure
Love is pure – the only treasure

I'm so in love with you
Purge the soul
Make love your goal

The power of love
A force from above
Cleaning my soul
The power of love
A force from above
A sky-scraping dove

Flame on burn desire
Love with tongues of fire
Purge the soul
Make love your goal

Frankie Goes To Hollywood

APPENDIX

Cowan-Kaufman-Morell Statement on Virus Isolation (SOVI)

Isolation: The action of isolating; the fact or condition of being isolated or standing alone; separation from other things or persons; solitariness
Oxford English Dictionary

The controversy over whether the SARS-CoV-2 virus has ever been isolated or purified continues. However, using the above definition, common sense, the laws of logic and the dictates of science, any unbiased person must come to the conclusion that the SARS-CoV-2 virus has never been isolated or purified. As a result, no confirmation of the virus' existence can be found. The logical, common sense, and scientific consequences of this fact are:

- the structure and composition of something not shown to exist can't be known, including the presence, structure, and function of any hypothetical spike or other proteins;
- the genetic sequence of something that has never been found can't be known;
- "variants" of something that hasn't been shown to exist can't be known;
- it's impossible to demonstrate that SARS-CoV-2 causes a disease called Covid-19.

In as concise terms as possible, here's the proper way to isolate, characterize and demonstrate a new virus. First, one takes samples (blood, sputum, secretions) from many people (e.g. 500) with symptoms which are unique and specific enough to characterize an illness. Without mixing these samples with ANY tissue or products that also contain genetic material, the virologist macerates, filters and ultracentrifuges i.e. *purifies* the specimen. This common virology technique, done for decades to isolate bacteriophages[1] and so-called giant viruses in every virology lab, then allows the virologist to demonstrate with electron microscopy thousands of identically sized and shaped particles. These particles are the isolated and purified virus.

These identical particles are then checked for uniformity by physical and/or microscopic techniques. Once the purity is determined, the particles may be further characterized. This would include examining the structure, morphology, and chemical composition of the particles. Next, their genetic makeup is characterized by extracting the genetic material directly from the purified particles and using genetic-sequencing techniques, such as Sanger sequencing, that have also been around for decades. Then one does an analysis to confirm that these uniform particles are exogenous (outside) in origin as a virus is conceptualized to be, and not the normal breakdown products of dead and dying tissues.[2] (As of May 2020, we know that virologists have no way to determine whether the particles they're seeing are viruses or just normal breakdown products of dead and dying tissues.)[3]

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1 Isolation, characterization and analysis of bacteriophages from the haloalkaline lake Elmenteita, KenyaJuliah Khayeli Akhwale et al, PLOS One, Published: April 25, 2019. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0215734 – accessed 2/15/21

2 "Extracellular Vesicles Derived From Apoptotic Cells: An Essential Link Between Death and Regeneration," Maojiao Li1 et al, Frontiers in Cell and Developmental Biology, 2020 October 2. https://www.frontiersin.org/articles/10.3389/fcell.2020.573511/full – accessed 2/15/21

3 "The Role of Extraellular Vesicles as Allies of HIV, HCV and SARS Viruses," Flavia Giannessi, et al, Viruses, 2020 May

If we have come this far then we have fully isolated, characterized, and genetically sequenced an exogenous virus particle. However, we still have to show it is causally related to a disease. This is carried out by exposing a group of healthy subjects (animals are usually used) to this isolated, purified virus in the manner in which the disease is thought to be transmitted. If the animals get sick with the same disease, as confirmed by clinical and autopsy findings, one has now shown that the virus actually causes a disease. This demonstrates infectivity and transmission of an infectious agent.

None of these steps has even been attempted with the SARS-CoV-2 virus, nor have all these steps been successfully performed for any so-called pathogenic virus. Our research indicates that a single study showing these steps does not exist in the medical literature.

Instead, since 1954, virologists have taken unpurified samples from a relatively few people, often less than ten, with a similar disease. They then minimally process this sample and inoculate this unpurified sample onto tissue culture containing usually four to six other types of material – all of which contain identical genetic material as to what is called a "virus." The tissue culture is starved and poisoned and naturally disintegrates into many types of particles, some of which contain genetic material. Against all common sense, logic, use of the English language and scientific integrity, this process is called "virus isolation." This brew containing fragments of genetic material from many sources is then subjected to genetic analysis, which then creates in a computer-simulation process the alleged sequence of the alleged virus, a so called in silico genome. At no time is an actual virus confirmed by electron microscopy. At no time is a genome extracted and sequenced from an actual virus. This is scientific fraud.

The observation that the unpurified specimen — inoculated onto tissue culture along with toxic antibiotics, bovine fetal tissue, amniotic fluid and other tissues — destroys the kidney tissue onto which it is inoculated is given as evidence of the virus' existence and pathogenicity. This is scientific fraud.

From now on, when anyone gives you a paper that suggests the SARS-CoV-2 virus has been isolated, please check the methods sections. If the researchers used Vero cells or any other culture method, you know that their process was not isolation. You will hear the following excuses for why actual isolation isn't done:

1. There were not enough virus particles found in samples from patients to analyze.

2. Viruses are intracellular parasites; they can't be found outside the cell in this manner.

If No. 1 is correct, and we can't find the virus in the sputum of sick people, then on what evidence do we think the virus is dangerous or even lethal? If No. 2 is correct, then how is the virus spread from person to person? We are told it emerges from the cell to infect others. Then why isn't it possible to find it?

Finally, questioning these virology techniques and conclusions is not some distraction or divisive issue. Shining the light on this truth is essential to stop this terrible fraud that humanity is confronting. For, as we now know, if the virus has never been isolated, sequenced or shown to cause illness, if the virus is imaginary, then why are we wearing masks, social distancing and putting the whole world into prison?

Finally, if pathogenic viruses don't exist, then what is going into those injectable devices erroneously called "vaccines," and what is their purpose? This scientific question is the most urgent and relevant one of our time.

We are correct. The SARS-CoV2 virus does not exist.

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Dr. Thomas Cowan, MD
Dr. Andrew Kaufman, MD

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Across the range of subjects and positions of influence occupied mainly by people who don't strive to make things better it's the Media that I have always found the most frustrating and fascinating. Mainly because if the Media did their Jobs properly then so much of the negative things happening in the World simply would not be able to happen, because they would be exposed within a heartbeat.
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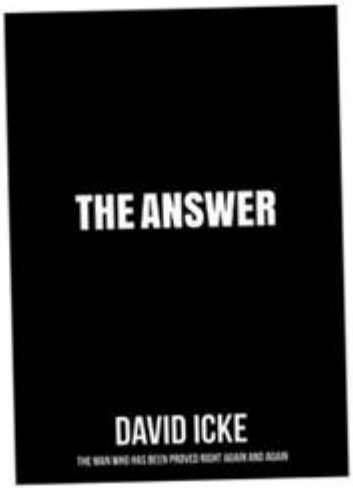

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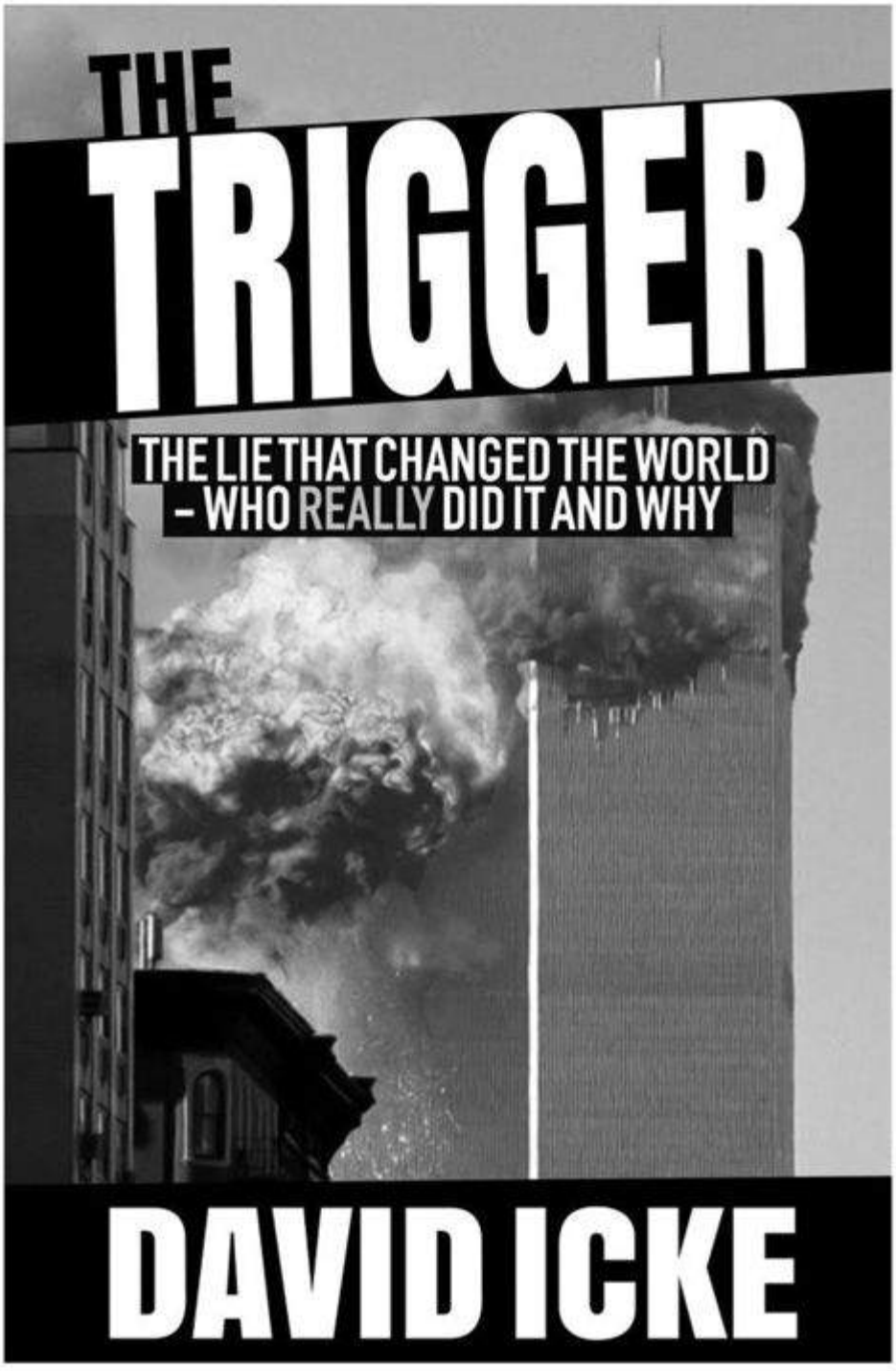
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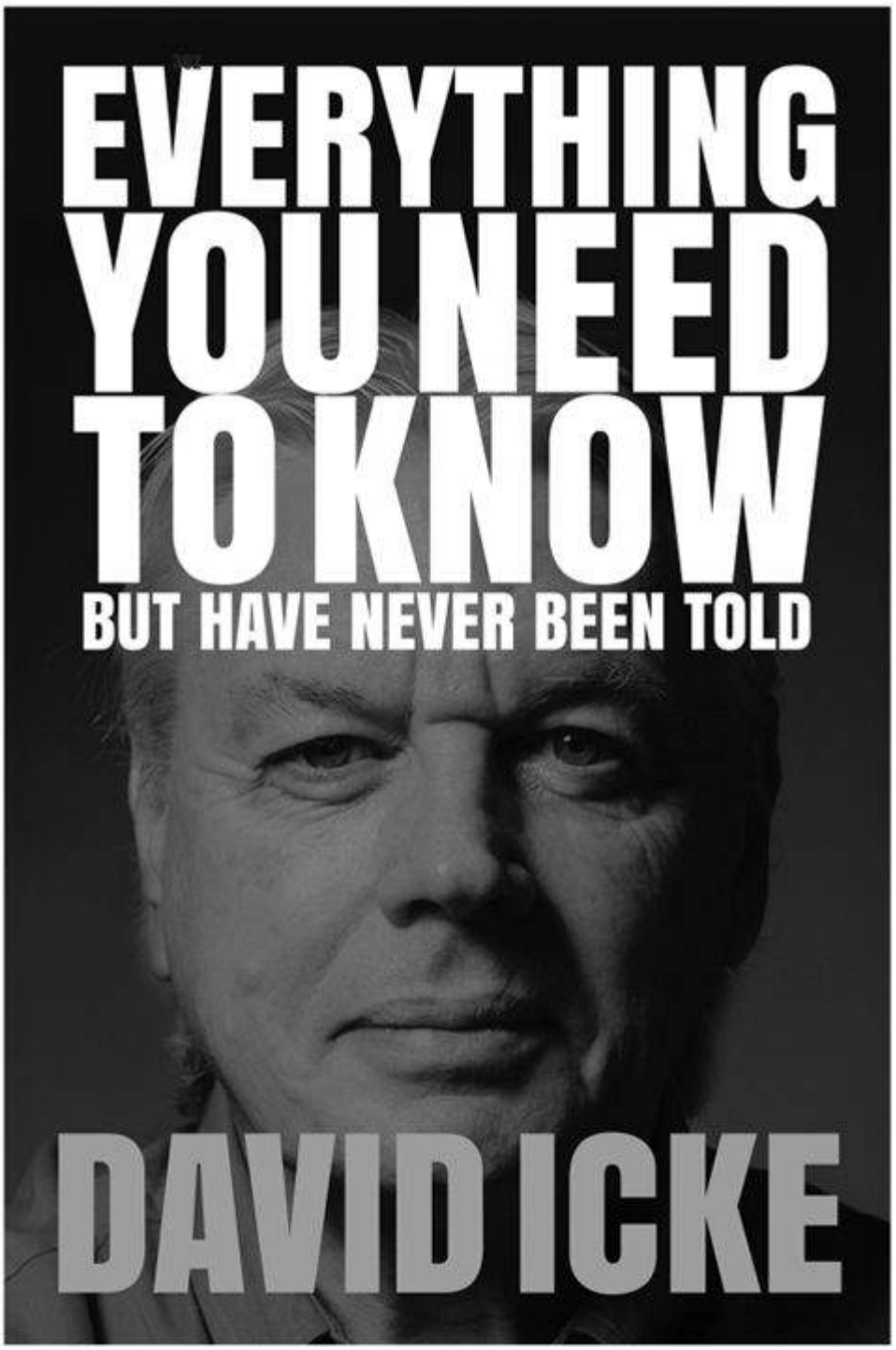
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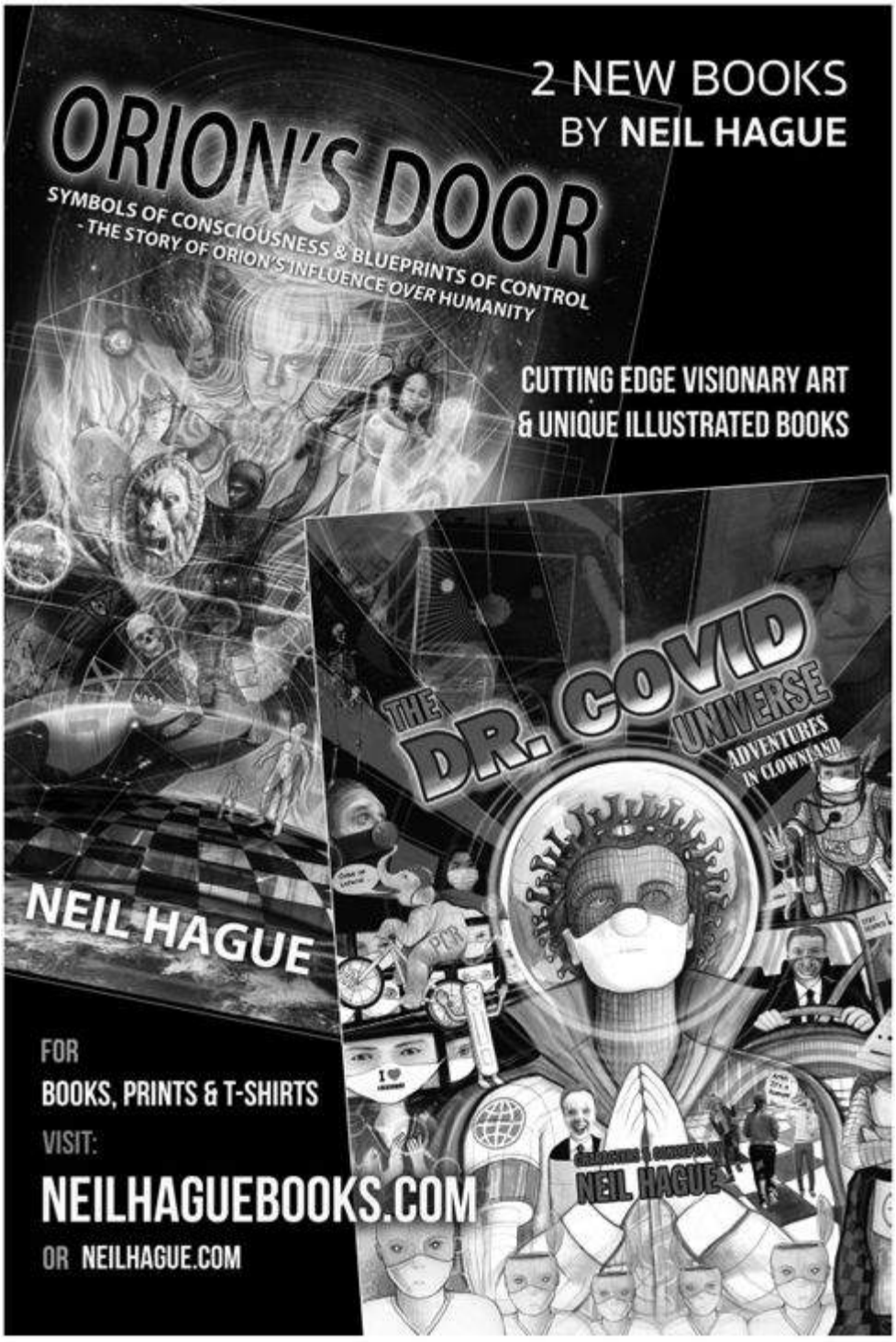
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